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FLUKE

5700A
CALIBRATOR

Operator Manual

P/N 791905
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FLUKE

WARRANTY

John Fluke Mfg. Co., Inc. (Fluke) warrants this instrument to be free from defects in material and workmanship under normal use and service for a period of 1 year from date of shipment. Software is warranted to operate in accordance with its programmed instructions on appropriate Fluke instruments. It is not warranted to be error free. This warranty extends only to the original purchaser and shall not apply to fuses, computer media, batteries or any instrument which, in Fluke's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or handling.

Fluke's obligation under this warranty is limited to repair or replacement of an instrument which is returned to an authorized service center within the warranty period and is determined, upon examination by Fluke, to be defective. If Fluke determines that the defect or malfunction has been caused by misuse, alteration, abuse, or abnormal conditions of operation or handling, Fluke will repair the instrument and bill the purchaser for the reasonable cost of repair. If the instrument is not covered by this warranty, Fluke will, if requested by purchaser, submit an estimate of the repair costs before work is started.

To obtain repair service under this warranty purchaser must forward the instrument, (transportation prepaid) and a description of the malfunction to the nearest Fluke Service Center. The instrument shall be repaired at the Service Center or at the factory, at Fluke's option, and returned to purchaser, transportation prepaid. FLUKE ASSUMES NO RISK FOR IN-TRANSIT DAMAGE.

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

CLAIMS

Immediately upon arrival, purchaser shall check the packing container against the enclosed packing list and shall, within thirty (30) days of arrival, give Fluke notice of shortages or any nonconformity with the terms of the order, If purchaser fails to give notice, the delivery shall be deemed to conform with the terms of the order.

The purchaser assumes all risk of loss or damage to instruments upon delivery by Fluke to the carrier. If an instrument is damaged in transit, PURCHASER MUST FILE ALL CLAIMS FOR DAMAGE WITH THE CARRIER to obtain compensation. Upon request by purchaser, Fluke will submit an estimate of the cost to repair shipment damage.

Fluke will be happy to answer all questions to enhance the use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WA 98206,

Declaration of the Manufacturer or Importer

We hereby certify that the Fluke Model 5700A is in compliance with Postal Regulation Vfg. 1046 and is RFI suppressed. The marketing and sale of the equipment was reported to the German Postal Service. The right to retest this equipment to verify compliance with the regulation was given to the German Postal Service.

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß Fluke Model 5700A in Übereinstimmung mit den Bestimmungen der Amtsblattverfügung Vfg. 1046 funk-entstört ist. Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

John Fluke Mfg. Co., Inc.

INTERFERENCE INFORMATION

This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the equipment with respect to the receiver
- Move the equipment away from the receiver
- Plug the equipment into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00345-4.

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OPERATOR SAFETY SUMMARY

WARNING

HIGH VOLTAGE

is used in the operation of this equipment

LETHAL VOLTAGE

MAY BE PRESENT ON THE TERMINALS. OBSERVE ALL SAFETY PRECAUTIONS!

TO AVOID ELECTRICAL SHOCK HAZARD, THE OPERATOR SHOULD NOT ELECTRICALLY CONTACT THE OUTPUT HI OR SENSE HI BINDING POSTS. DURING OPERATION, LETHAL VOLTAGES OF UP TO 1100V AC OR DC MAY BE PRESENT ON THESE TERMINALS.

WHENEVER THE NATURE OF THE OPERATION PERMITS, KEEP ONE HAND AWAY FROM EQUIPMENT TO REDUCE THE HAZARD OF CURRENT FLOWING THROUGH VITAL ORGANS OF THE BODY.

TERMS IN THIS MANUAL

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus. This Operator Manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

SYMBOLS MARKED ON EQUIPMENT

DANGER — High voltage.

Protective ground (earth) terminal.

Attention — refer to the manual. This symbol is to indicate that information about usage of a feature is contained in the manual.

POWER SOURCE

The 5700A is intended to operate from a power source that will not apply more than 264V ac rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified on the line voltage selection switch label, and which is identical in type, voltage rating, and current rating.

GROUNDING THE 5700A

The 5700A is a Safety Class I (grounded enclosure) instrument as defined in IEC 348. The enclosure is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired earth grounded receptacle before connecting anything to any of the 5700A terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER POWER CORD

Use only the power cord and connector appropriate for proper operation of a 5700A in your country.

Use only a power cord that is in good condition.

For detailed information on power cords refer to Figure 2-3 in Section 2.

Refer cord and connector changes to qualified service personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate the 5700A in an atmosphere of explosive gas.

DO NOT REMOVE COVER

To avoid personal injury, do not remove the 5700A cover. Do not operate the 5700A without the cover properly installed. There are no user-serviceable parts inside the 5700A, so there is no need for the operator to ever remove the cover.

FIRST AID FOR ELECTRIC SHOCK

RESCUE

FREE VICTIM FROM CONTACT WITH LIVE CONDUCTOR QUICKLY. AVOID CONTACT WITH EITHER LIVE CONDUCTOR OR VICTIM'S BODY.

Shut off high voltage at once and ground circuit. If high voltage cannot be turned off quickly, ground circuit.

An ax with a dry wooden handle may be used to cut high voltage line. Use extreme caution to avoid resulting electric flash.

If circuit cannot be broken or grounded, use a dry board, dry clothing, or other nonconductor to free victim.

SYMPTOMS

NEVER ACCEPT ORDINARY AND GENERAL TESTS FOR DEATH.

Symptoms of electric shock may include unconsciousness, failure to breathe, absence of pulse, pallor, and stiffness, as well as severe burns. WHENEVER VICTIM IS NOT BREATHING PROPERLY, GIVE ARTIFICIAL RESPIRATION.

TREATMENT

START ARTIFICIAL RESPIRATION IMMEDIATELY.

Perform artificial respiration at scene of accident, unless victim's or operator's life is endangered. IN THIS CASE ONLY, remove victim to safe location nearby. If new location is more than a few feet away, give artificial respiration while victim is being moved.

After starting artificial respiration, continue without loss of rhythm for at least FOUR HOURS, or until victim is breathing without help. If you have to change operators while giving artificial respiration, do so without losing rhythm of respiration.

AFTER VICTIM REVIVES

Be prepared to resume artificial respiration, as he may stop breathing again.

When victim is COMPLETELY CONSCIOUS, give him a stimulant (NOT AN ALCOHOLIC DRINK) such as a teaspoonful of aromatic spirits of ammonia in a small glass of water, hot coffee, or hot tea.

Keep victim warm and lying down until he has been conscious for at least fifteen minutes.

POSITION VICTIM

Place victim in face-upward position and kneel close to his ear.

CLEAR THROAT

Turn head to one side and quickly wipe out any fluid, mucus, or foreign body from mouth and throat with fingers.

OPEN AIR PASSAGE

Tilt head back and extend neck to open air passage.

LIFT JAW FORWARD

Place thumb in victim's mouth and grasp jaw firmly. Lift jaw forward to pull tongue out of air passage. Do not attempt to hold or depress tongue.

PINCH NOSTRILS CLOSED

With other hand pinch nostrils closed to prevent air leak.

FORM TIGHT SEAL WITH LIPS

Rescuer's wide-open mouth completely surrounds and seals open mouth of victim. This is not a kissing or puckered position — mouth of rescuer must be wide-open.

BLOW

Exhale firmly into victim's mouth until chest is seen to lift. This can be seen by rescuer without difficulty.

REMOVE MOUTH AND INHALE

During this time, rescuer can hear and feel escape for air from lungs. Readjust position if air does not flow freely in and out of victim's lungs.

Continue at a rate of 12 to 20 times per minute.

Breathing should be normal in rate with only moderate increase in volume, so that rescue breathing can be continued for long periods without fatigue. Do not breathe too forcibly or too large a volume if victim is an infant or small child.

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5700A Calibrator

Section 1
Introduction and Specifications

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INTRODUCTION 1-1.

The Fluke Model 5700A Calibrator is a precise instrument that calibrates a wide variety of electrical measuring instruments. The 5700A maintains high accuracy over a wide ambient temperature range, allowing it to test instruments wherever they are, rather than only in a temperature-controlled standards laboratory. With a 5700A, you can calibrate precision multimeters that measure ac or dc voltage, ac or dc current, and resistance. Option 5700A-03 Wideband AC Voltage extends this workload to include many rf voltmeters.

Specifications for the 5700A are provided at the end of this section. The 5700A is a fully-programmable precision source of the following:

- DC voltage to 1100V
- AC voltage to 1100V, with output available from 10 Hz to 1.2 MHz
- AC and DC current to 2.2A, with output available from 10 Hz to 10 kHz.
- Resistance in values of $1x10^n$ and $1.9x10^n$ from short to 100 MΩ
- Optional wideband ac voltage from 300 μV to 3.5V (-57 dBm to +24 dBm), 10 Hz to 30 MHz.

Features of the 5700A include the following:

- Internal environmentally-controlled references allowing the 5700A to maintain full performance over a wide ambient operating temperature range.
- Automatic meter error calculation using a simple output adjust knob; the display shows linearity, offset, and scale errors.
- Keys that multiply and divide the output value by 10 to simplify work on meters with calibration points at decade multiples of a fraction of full-scale.
- Programmable entry limits to restrict levels that may be keyed into the 5700A, to prevent calling up a level that may be harmful to equipment or personnel.
- An auxiliary current binding post that allows you to complete calibration procedures for meters with separate current inputs without moving cables.
- Real-time clock and calendar for date stamping reports, and recording the time and date of calibration.
- Offset and scaling modes that simplify linearity testing of multimeters.
- Variable phase reference signal output and phase-lock input.
- Interfaces included as standard equipment for Fluke 5725A, 5220A, and 5205A or 5215A Amplifiers.
- Standard IEEE-488 (GPIB) interface, complying with ANSI/IEEE Standards 488.1-1987 and 488.2-1987.
- Selectable normal remote mode or emulation of the Fluke 5100B Series Calibrators in functions and response to system controller software.
- EIA Standard RS-232-C serial data interface for printing, displaying, or transferring internally-stored calibration constants, and for remote control of the 5700A.
- Extensive automatic internal self testing and diagnostics of analog and digital functions.
- A traceable calibration procedure for all modes and ranges that requires only 10V, 1Ω, and 10 kΩ external standards, with only occasional independent verification.
- Fast, simple, automated calibration check providing added confidence between calibration recalls, and data that can be used to document and characterize 5700A performance between calibration recalls.

WHERE TO GO FROM HERE 1-2.

For more information about:

- Quick setup and go procedure: See the 5700A Getting Started Guide
- Unpacking and setup: Section 2
- The manual set: Next in this section
- Installation and rack mounting: Section 2 and the rack mount kit instruction sheet
- AC line power and interface cabling: Section 2
- Controls, indicators, and displays: Section 3
- Front panel operation: Section 4
- Cabling to a UUT (Unit Under Test): Section 4
- Using auxiliary amplifiers: Section 4
- Self calibration: Sections 1 and 7
- Remote operation (IEEE-488 or serial): Section 5
- Options and accessories: Sections 2 and 8
- Instrument specifications: The end of this section
- Theory of operation: Section 2 of the 5700A Service Manual
- Where to locate a specific topic: Index

INSTRUCTION MANUALS 1-3.

This operator manual gives operating instructions for the Fluke Model 5700A Calibrator. The 5700A Manual Set provides complete information for the operator and service or maintenance personnel. The set includes the following manuals:

- 5700A Getting Started Guide P/N 791962
- 5700A Operator Manual P/N 791905
- 5700A Operator Reference Guide P/N 813568
- 5700A Remote Programming Reference Guide P/N 813550
- 5700A Service Manual P/N 791996

Each of the manuals listed above is shipped with every instrument. The two reference guides are packaged inside this 5700A Operator Manual. Order additional copies of the manuals or reference guides separately using the part number provided. For ordering instructions, refer to the Fluke Catalog, or ask a Fluke sales representative.

5700A Getting Started Guide 1-4.

The 5700A Getting Started Guide provides a step-by-step, hands-on approach to calibrator operation. The guide gives the new user a quick, positive feel for the 5700A and is the best place to start working with the 5700A. This guide demonstrates both local and remote operation.

5700A Operator Manual 1-5.

This 5700A Operator Manual provides complete information for installing the 5700A and operating the 5700A from the front panel keys and in remote. It also provides a glossary of calibration-related terms as well as general items such as specifications and error code information. The following topics are covered in this 5700A Operator Manual:

- Installation
- Operating controls and features
- Front panel operation
- Remote operation (IEEE-488 bus or serial port remote control)
- Serial port operation (printing, displaying, or transferring data, and setting up for serial port remote control)
- Operator maintenance, including how to calibrate the 5700A
- Options and accessories

The 5700A Operator Manual includes two pocket-sized fold-out reference cards; one for front panel operation and one for remote programming.

5700A Operator Reference Guide 1-6.

The 5700A Operator Reference Guide contains a summary of operating instructions from the Operator Manual. This reference guide contains information needed to start up and operate the 5700A. It contains a front and rear feature reference and a softkey menu tree. The guide is included with this 5700A Operator Manual.

The 5700A Remote Programming Reference Guide 1-7.

The 5700A Remote Programming Reference Guide contains a summary of remote commands for the 5700A. It also contains information needed to determine system status using the status byte and registers. This reference guide is also included with this 5700A Operator Manual.

5700A Service Manual 1-8.

The 5700A Service Manual is a maintenance guide for the 5700A. The following topics are included in the 5700A Service Manual:

- Theory of operation
- Performance testing
- Maintenance
- Calibration
- Troubleshooting
- Parts lists
- Schematics

WIDEBAND AC VOLTAGE MODULE (OPTION 5700A-03) 1-9.

The Wideband AC Voltage Module (Option 5700A-03) is a high-accuracy, low-noise, extremely flat ac voltage source with a frequency range of 10 Hz to 30 MHz. With the wideband module, the 5700A can calibrate rf voltmeters. Output is in seven ranges from 300 μV (-57 dBm) to 3.5V (+24 dBm) through a Type "N" coaxial connector into a 50Ω load. Output level is selected in volts or dBm through either the front panel controls or under remote control.

The wideband module also functions with the 5700A output adjust controls, allowing you to display the error of a wideband meter in percentage of output or decibels.

Included with the wideband module are a Type "N" output cable and a 50Ω The wideband terminator. module is calibrated to the end of its standard-equipment output cable.

AUXILIARY AMPLIFIERS 1-10.

Four amplifiers are available to extend the high voltage performance and current range of the 5700A:

- Fluke Model 5725A Amplifier
- Fluke Model 5205A Precision Power Amplifier
- Fluke Model 5215A Precision Power Amplifier
- Fluke Model 5220A Transconductance Amplifier

Interface connectors on the 5700A rear panel accept cables to directly operate a 5725A, a 5220A, and either a 5205A or 5215A. Three amplifiers can be connected to the 5700A at the same time, but only one output can be active at a time. Once you have connected the amplifiers and configured the 5700A in a setup menu, amplifier operation is controlled by the 5700A.

Section 4 provides instructions for operating each amplifier. The general specifications at the end of this section include specifications for operating the 5700A with the 5725A. For other amplifier specifications, refer to their instruction manuals. Table 1-1 summarizes the extended capabilities offered by each amplifier. Brief descriptions of the extended capabilities follow.

Table 1-1. Auxiliary Amplifier Data

MODEL	MODE	RANGE
5725A Amplifier	ac V	20 to 1100V rms up to 70 mA, 40 Hz to 30 kHz (50 mA < 5 kHz)
		220 to 750V rms up to 70 mA, 30 kHz to 100 kHz
	dc I	0 to ±11A
	ac I	1 to 11A rms, 10 Hz to 10 kHz
5205A Precision Power Amplifier	dc V	±1100V rms @ 70 mA
	ac V	1100V rms @ 200 mA, 10 Hz to 100 kHz
5215A Precision Power Amplifier	ac V	1100V rms @ 200 mA, 10 Hz to 100 kHz
5220A Transconductance Amplifier	dc I	±1 to ±19.9999A
	ac I	1 to 19.9999A rms, 30 Hz to 5 kHz

5725A Amplifier 1-11.

The Fluke 5725A Amplifier is an external unit operating under 5700A control to extend ac voltage drive capabilities and both ac and dc current output range. The amplifier adds the following capabilities to the 5700A 1100V ac range with no compromise in accuracy:

- Frequency limits at higher voltage increase to 100 kHz at 750V, 30 kHz at 1100V.
- Load limit increases to 70 mA for frequencies above 5 kHz.
- Capacitive drive increases to 1000 pF, subject to the maximum output current.

Extended-performance voltage is available at the 5700A front or rear binding posts, eliminating the need to change cables during a procedure.

A separate set of binding posts on the front panel of the 5725A supplies extended-range ac and dc current outputs. Since most meters have a separate input terminal for the high current ranges, this eliminates the need to change cables during a procedure. The 5725A can also be configured to source all current (both standard 5700A-generated current and its own current) through the 5725A binding posts.

5205A and 5215A Precision Power Amplifiers 1-12.

The Fluke 5205A and 5215A Precision Power Amplifiers extend 5700A high voltage load and frequency capabilities for demanding applications. A 5205A or 5215A adds the following capabilities to the 5700A 1100V ac voltage range with accuracy sensing at the load point:

- Frequency limit at higher voltage increases to 100 kHz at 1100V.
- Resistive load limit increases to 200 mA.
- Capacitive load limit increases to 1500 pF.

In addition, a 5205A increases 5700A 1100V dc load limits to 70 mA and 1500 pF.

A 5205A or 5215A allows the 5700A to reach higher volt-hertz products occasionally called for, and to maintain high accuracy with heavy loads and long cables.

5220A Transconductance Amplifier 1-13.

The Fluke 5220A Transconductance Amplifier extends the ac and dc current capability of the 5700A to 20A. This high-current output lets you calibrate current meters and shunts, as well as the high-current functions of DMMs and VOMs. High compliance voltage means the 5220A can sustain full output current through multi-turn fixtures for calibrating current transformer and Hall-effect probes.

SUPPORT EQUIPMENT AND SERVICES 1-14.

Fluke supports your calibration needs with precision, high-quality equipment and a wide range of services. Depending on your needs, location, and capabilities, you may decide to support your 5700A independently or use Fluke services for a part of or all of your support needs. The following paragraphs describe the support equipment and services offered by Fluke for the 5700A. For specifications and ordering instructions for this support equipment and other Fluke instruments, refer to the Fluke catalog, or contact a representative at a Fluke Sales and Service Center.

732A Direct Voltage Reference Standard 1-15.

The Fluke 732A is a rugged, easily transported solid state direct voltage reference standard with a highly predictable 10V output. This predictability allows the Fluke Standards Laboratory, as well as many Fluke customers, to completely eliminate fragile, saturated standard cells. Many laboratories maintaining standard cells use the 732A as a transportable voltage standard, eliminating the need to transport their standard cells. The 732A can be short-circuited, even for extended periods of time, without damage or loss of stability. It maintains full specified stability over a temperature span of 18 to 28°C.

The 5700A uses a 10V reference standard such as the Fluke 732A in its semi-automated calibration procedure to establish external voltage traceability. Section 7 describes this procedure.

732A-200 Direct Volt Maintenance Program (U.S.A. Only) 1-16.

The Fluke 732A-200 Direct Volt Maintenance Program provides your laboratory with NBS-traceable 10V calibration uncertainty as low as 0.6 parts per million with MIL-STD-45662 compliance.

The program maintains the 732A that you keep in your laboratory. To accomplish this, the following occurs:

- Fluke sends you a calibrated Fluke-owned 732A standard, together with all necessary connecting cables and instructions for comparison with your 10V reference standard.
- You take a series of readings over a five-day period, and return the results to the Fluke Standards Laboratory.
- The Fluke Standards Laboratory assigns a value to your 10V standard relative to the NBS legal volt and sends you a report of calibration.

742A Series Resistance Standards 1-17.

The 5700A uses 1Ω and 10 kΩ resistance standards such as the 742A Series in its semi-automated calibration procedure to establish external traceability of resistance and current. Section 7 describes this procedure.

The 742A Resistance Standards, which are constructed of arrays of Fluke wirewound precision resistors, are ideally suited as support standards for the 5700A. Stability of the resistance standards and their temperature coefficients make them ideal for easy transport to and operation in the calibrator's working environment.

Wideband AC Module (Option 5700A-03) Calibration Support 1-18.

The Wideband AC Module (Option 5700A-03) requires two kinds of calibration: gain and flatness. Gain constants are checked and recalibrated as a part of the normal 5700A semi-automated calibration process.

Because frequency flatness is determined by such stable parameters as circuit geometry and dielectric constants, flatness of the Wideband AC Module has excellent long-term stability. This stability gives the Wideband AC Module a two-year calibration cycle for flatness calibration. Flatness calibration is required only infrequently, and can be done when the 5700A is returned to a standards laboratory for periodic verification. The 5700A Service Manual contains the wideband flatness calibration procedure. Section 7 of this manual contains the wideband gain calibration procedure.

Technical Service Centers 1-19.

A worldwide network of Fluke technical service centers supports Fluke instruments and assists customers in many ways. (A complete list of technical service centers is provided in Appendix E.) Most technical service centers have standards and calibration laboratories certified by local national standards organizations. The following is a partial list of the services provided by most technical service centers:

- Repair and certified traceable calibration of all Fluke products.
- Certified traceable calibration of many non-Fluke standards and calibrators.
- Worldwide exchange of 5700A internal modules. Delivery inside the U.S.A. is typically within 48 hours.
- Service agreements with the flexibility to suit your needs. These can be a simple warranty extension or an agreement that includes on-site support. Calibration service agreements are also available in many areas.
- Training programs and seminars, including laboratory metrology, system applications, and product maintenance.
- Application help and consulting, including system design, hardware selection, custom software, site evaluation and installation.
- Replacement parts inventory, including recommended spare parts and module kits.

INSIDE THE 5700A 1-20.

The 5700A is configured internally as an automated calibration system with process controls and consistent procedures. Internal microprocessors control all functions and monitor performance, using a switching matrix to route signals between modules. Complete automatic internal diagnostics, both analog and digital, confirm operational integrity.

Reference amplifiers maintain dc accuracy and stability. Of all technologies available, reference amplifiers have the lowest noise and best stability. Reference amplifiers in the 5700A go through special selection processes including long-term aging to ensure high reliability and performance well within specifications.

The 5700A achieves its exceptional ac voltage accuracy by using a patented Fluke rms sensor to make real-time ac/dc comparison measurements. The Fluke rms sensor is similar in principle to the traditional thermal voltage converter, but has a shorter time constant, virtually no reversal error, higher signal-to-noise ratio, and better frequency response. In the 5700A, one Fluke rms sensor serves as an ac/dc transfer standard to develop gain and flatness correction constants during calibration. The second Fluke rms sensor continuously monitors and corrects output voltage during operation.

A patented 26-bit digital-to-analog converter (dac) provides the 5700A with the ability to precisely vary its output. This is a pulse-width modulated dac with linearity typically better than 0.2 ppm of full scale. As with the other 5700A internal functions, the linearity of the dac is automatically checked during calibration and analog diagnostics.

HOW THE 5700A IS CALIBRATED 1-21.

Traditional practice is to bring a calibrator back to a standards laboratory at regular intervals for a full calibration. This is time consuming, expensive, and disruptive to the task to which the calibrator is being applied.

Moreover, it leaves gaps in confidence. You must rely on manufacturer's specifications to determine if a calibrator will perform acceptably in an operating environment outside the lab. Also, you must assume that drift is predictable enough so that performance is within limits between recalls.

The 5700A Calibrator makes use of Fluke design breakthroughs in the use of internal check standards and measurement systems. As a result, it can be completely calibrated in place to full specifications using a small number of convenient, portable, environmentally tolerant standards available from Fluke. As you will see below, this procedure is traceable to military standard requirements.

When manufactured, each 5700A is calibrated and thoroughly verified with process metrology and calibration standards traceable to the U.S. National Bureau of Standards. A certificate of calibration is included.

A calibration verification procedure described in the 5700A Service Manual is recommended every two years, or as required by your established policies. This procedure involves no adjustments. It simply ensures internal processes are in control, and establishes parallel external traceability paths for internal functions such as ac transfers that are never adjusted or corrected.

Figure 1-1 illustrates the time and money savings realized by using the 5700A calibration support plan recommended by Fluke. Depending on your policies, you may initially decide to perform calibration verification more often. But the 5700A makes this unnecessary. And the 5700A offers you for the first time a practical way to collect data unavailable with a traditional calibrator design about performance between calibrations.

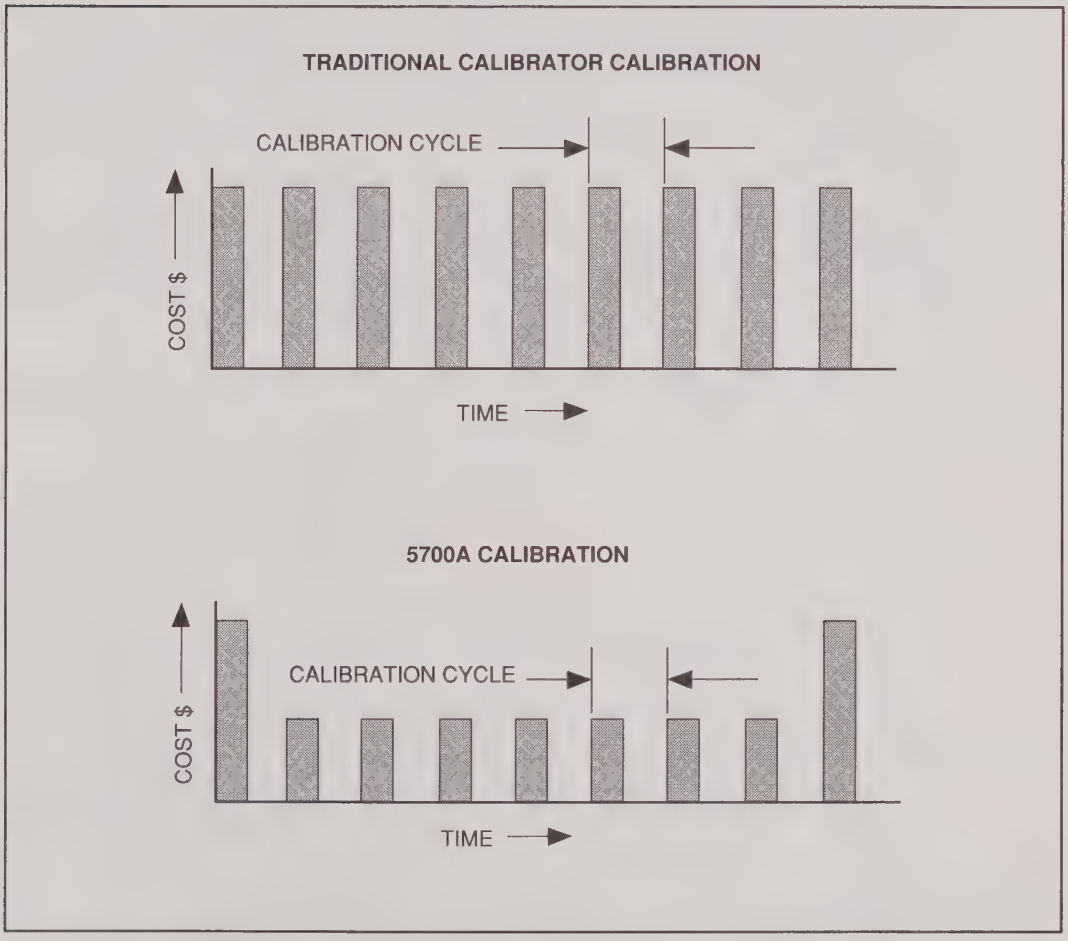


Figure 1-1. Time and Money Costs: Calibrator Calibration

The Calibration Process 1-22.

5700A calibration requires only three external standards: 10V, 1Ω, and 10 kΩ. Environmentally-controlled internal check standards provide the primary reference points. A stored table of calibration constants defines additional reference points for controlling the output. Traceable calibration and adjustment to the specified level of performance is accomplished in a semi-automated process that revises this table.

When you finish calibration, but before you save the new constants, the 5700A presents you with the proposed adjustments as ± ppm of range and percentage change in specification for each range and function. You can print a list of changes through the serial (RS-232-C) port, or send them to a computer through either the serial port or the IEEE-488 port. Also on completion of calibration, the 5700A displays the largest proposed change.

Calibration can be completed as far as deriving and printing the proposed adjustments without changing the setting of the rear panel CALIBRATION switch; however, the switch must be set to ENABLE to store the changes in nonvolatile memory and make them effective. The switch is recessed to allow the metrologist to cover it with a calibration sticker to guarantee calibrator integrity.

Establishment of Traceability 1-23.

Traceability to national standards is established as follows:

- Except for the internal ac/dc transfer standard, the internal check standards are directly calibrated by traceable external standards every time the 5700A is calibrated.

- The internal ac/dc transfer standard is never adjusted, so its traceability is not disturbed by 5700A calibration. Infrequent verification is done in the traditional way, by comparing selected ac voltage outputs with an external dc voltage standard through an external ac/dc transfer standard. Fluke recommends this be done every every two years, or as determined by the policy of your organization.

- Infrequent independent verification is also performed on stable parameters, such as frequency flatness, determined more by circuit geometry and dielectric constants than time.

Calibration Reports 1-24.

The 5700A stores two sets of calibration constants: the set currently in use and the old set from the previous calibration. This gives the 5700A the ability at any time to produce a calibration report of the differences between the present settings and the settings that were in effect before the last calibration. The report shows changes for each range and function in ± ppm of range and in percentage of specification limit. You can print the report or send it to a host computer through either the RS-232-C or IEEE-488 interface.

If you request a calibration report after doing calibration but before saving the new constants, the report shows proposed changes to the calibration constants relative to the previously stored settings.

CALIBRATION CHECK 1-25.

Calibration check (cal check) provides you with an easy way to develop documentary evidence of the performance of a particular 5700A between calibrations. Cal check takes about an hour to run. It is similar to calibration, except internal check standards are used as primary references (no external standards are needed), and changes cannot be stored. The process produces a report similar to normal calibration, showing drift relative to internal check standards. Because cal check does not change stored calibration constants, there is no need to enable the rear panel CALIBRATION switch. Therefore, an external computer can do the procedure unattended.

DEVELOPING A PERFORMANCE HISTORY 1-26.

A Fluke specification is a set of performance limits that all products must meet. To maintain consistent quality, Fluke calibrators are specified with enough margin to include temperature, line, and load extremes, plus additional margin for production. This means that a typical 5700A Calibrator in a typical environment operates inside 50% of specification limits. For some exacting applications, it can be helpful to know just how accurately a particular 5700A operates. The proper way to do this is to accumulate a performance history by calibrating regularly and recording results on a control chart.

Calibrating regularly and recording the results on a control chart is tedious and requires a large array of equipment. The 5700A cal check feature is an alternative with some distinct advantages:

- Calibrated check standards are already inside the unit. You do not have to use external standards.
- The process is internally automated and consistent.
- It can be done by computer, unattended by a person.

Each cal check produces a new set of data points for accumulating a historical record. When this process is externally automated, significant history can be accumulated much faster than is reasonable to try to do using manual calibration.

RANGE CALIBRATION 1-27.

After calibration, you can make further fine adjustments to each range. Range adjustments are optional; they are not necessary to meet total uncertainty specifications. However, they do allow you to align your 5700A closer to your standards.

Before you do range calibration, you must first use the 5700A semi-automated calibration procedure to calibrate the 5700A. This is to calibrate the ranges that will not be adjusted. It also performs an initial adjustment for each range, and supplies flatness corrections for ac functions.

SPECIFICATIONS 1-28.

Table 1-2 provides specifications for the 5700A, including operation with the Wideband AC Module (Option 5700A-03) and the 5725A Amplifier.

Specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5700A has been turned off. For example, if the 5700A has been turned off for five minutes, the warm-up period is ten minutes.

To simplify evaluation of how the 5700A covers your calibration workload, use the 5700A Absolute Uncertainty specifications. Absolute uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and the traceability to external standards. You do not need to add anything to absolute uncertainty to determine the ratios between 5700A uncertainties and the uncertainties of your calibration workload.

Relative Uncertainty specifications are provided for enhanced accuracy applications. These specifications apply when range constants are adjusted (see "Range Calibration"). To calculate absolute uncertainty, you must combine the uncertainties of your external standards and techniques with relative uncertainty.

Secondary Performance Specifications and Operating Characteristics are included in uncertainty specifications. They are provided for special calibration requirements such as stability or linearity testing.

DC Voltage

Range	Resolution	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		±(ppm output + μV)				±(ppm output + μV)	
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8	2.5 + .5	4 + .5
2.2V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2	2.5 + 1.2	4 + 1.2
11V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4	1.5 + 3	3.5 + 4
22V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8	1.5 + 6	3.5 + 8
220V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100	2.5 + 100	4 + 100
1100V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600	3 + 600	4.5 + 600

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Stability ±1°C	Temperature Coefficient [Note]		Linearity ±1°C	Noise	
		10°-40°C	0°-10°C and 40°-50°C		Bandwidth 0.1-10 Hz	Bandwidth 10-10 kHz
	24 Hours				pk-pk	RMS
	±(ppm output + μV)	±(ppm output + μV)/°C		±(ppm output + μV)		μV
220 mV	.3 + .3	.4 + .1	1.5 + .5	1 + .2	.15 + .1	5
2.2V	.3 + 1	.3 + .1	1.5 + 2	1 + .6	.15 + .4	15
11V	.3 + 2.5	.15 + .2	1 + 1.5	.3 + 2	.15 + 2	50
22V	.4 + 5	.2 + .4	1.5 + 3	.3 + 4	.15 + 4	50
220V	.5 + 40	.3 + 5	1.5 + 40	1 + 40	.15 + 60	150
1100V	.5 + 200	.5 + 10	3 + 200	1 + 200	.15 + 300	500

Note: Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operating more than ±5°C from calibration temperature.

Minimum output: 0V for all ranges, except 100V for 1100V range

Maximum load: 50 mA for 2.2V through 220V ranges; 25 mA for 1100V range; 50Ω output impedance on 220 mV range; all ranges <1000 pF, >25Ω

Load regulation: <0.2 ppm change, full load to no load

Line regulation: <0.1 ppm change, ±10% of selected nominal line

Settling time: 3 seconds to full accuracy; +1 second for range or polarity change; +1 second for 1100V range

Overshoot: <5%

Common mode rejection: 140 dB, DC to 400 Hz

Remote sensing: Available 0V to ±1100V, on 2.2V through 1100V ranges

AC Voltage

Range	Resolution	Frequency	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	±(ppm output + μV)				±(ppm output + μV)	
2.2 mV	1 nV	10-20	500 + 5	550 + 5	600 + 5	600 + 5	500 + 5	550 + 5
		20-40	200 + 5	220 + 5	230 + 5	240 + 5	200 + 5	220 + 5
		40-20k	100 + 5	110 + 5	120 + 5	120 + 5	60 + 5	65 + 5
		20k-50k	340 + 5	370 + 5	390 + 5	410 + 5	100 + 5	110 + 5
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15	400 + 15	440 + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30	.10% + 30	.11% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30	.3% + 30	.33% + 30
22 mV	10 nV	10-20	500 + 6	550 + 6	600 + 6	600 + 6	500 + 6	550 + 6
		20-40	200 + 6	220 + 6	230 + 6	240 + 6	200 + 6	220 + 6
		40-20k	100 + 6	110 + 6	120 + 6	120 + 6	60 + 6	65 + 6
		20k-50k	340 + 6	370 + 6	390 + 6	410 + 6	100 + 6	110 + 6
		50k-100k	800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8
		100k-300k	.11% + 15	.12% + 15	.13% + 15	.13% + 15	400 + 15	440 + 15
		300k-500k	.15% + 30	.17% + 30	.17% + 30	.18% + 30	.10% + 30	.11% + 30
		500k-1M	.30% + 30	.33% + 30	.35% + 30	.36% + 30	.3% + 30	.33% + 30
220 mV	100 nV	10-20	500 + 16	550 + 16	600 + 16	600 + 16	500 + 16	550 + 16
		20-40	200 + 10	220 + 10	230 + 10	240 + 10	200 + 10	220 + 10
		40-20k	95 + 10	100 + 10	110 + 10	110 + 10	60 + 10	65 + 10
		20k-50k	300 + 10	330 + 10	350 + 10	360 + 10	100 + 10	110 + 10
		50k-100k	750 + 30	800 + 30	850 + 30	900 + 30	220 + 30	240 + 30
		100k-300k	940 + 30	.1% + 30	.11% + 30	.11% + 30	400 + 30	440 + 30
		300k-500k	.15% + 40	.17% + 40	.17% + 40	.18% + 40	.1% + 40	.11% + 40
		500k-1M	.30% + 100	.33% + 100	.35% + 100	.36% + 100	.3% + 100	.33% + 100
2.2V	1 μV	10-20	500 + 100	550 + 100	600 + 100	600 + 100	500 + 100	550 + 100
		20-40	150 + 30	170 + 30	170 + 30	180 + 30	150 + 30	170 + 30
		40-20k	70 + 7	75 + 7	80 + 7	85 + 7	40 + 7	45 + 7
		20k-50k	120 + 20	130 + 20	140 + 20	140 + 20	100 + 20	110 + 20
		50k-100k	230 + 80	250 + 80	270 + 80	280 + 80	200 + 80	220 + 80
		100k-300k	400 + 150	440 + 150	470 + 150	480 + 150	400 + 150	440 + 150
		300k-500k	.10% + 400	.11% + 400	.12% + 400	.12% + 400	.1% + 400	.11% + 400
		500k-1M	.20% + 1 mV	.22% + 1 mV	.23% + 1 mV	.24% + 1 mV	.2% + 1 mV	.22% + 1 mV
22V	10 μV	10-20	500 + 1 mV	550 + 1 mV	600 + 1 mV	600 + 1 mV	500 + 1 mV	550 + 1 mV
		20-40	150 + 300	170 + 300	170 + 300	180 + 300	150 + 300	170 + 300
		40-20k	70 + 70	75 + 70	80 + 70	85 + 70	40 + 70	45 + 70
		20k-50k	120 + 200	130 + 200	140 + 200	140 + 200	100 + 200	110 + 200
		50k-100k	230 + 400	250 + 400	270 + 400	280 + 400	200 + 400	220 + 400
		100k-300k	500 + 1.7 mV	550 + 1.7 mV	550 + 1.7 mV	600 + 1.7 mV	500 + 1.7 mV	550 + 1.7 mV
		300k-500k	.12% + 5 mV	.13% + 5 mV	.13% + 5 mV	.14% + 5 mV	.12% + 5 mV	.13% + 5 mV
		500k-1M	.26% + 9 mV	.28% + 9 mV	.29% + 9 mV	.30% + 9 mV	.26% + 9 mV	.28% + 9 mV
			±(ppm output + mV)				±(ppm output + mV)	
220V	100 μV	10-20	500 + 10	550 + 10	600 + 10	600 + 10	500 + 10	550 + 10
		20-40	150 + 3	170 + 3	170 + 3	180 + 3	150 + 3	170 + 3
		40-20k	75 + 1	80 + 1	85 + 1	90 + 1	45 + 1	50 + 1
		20k-50k	200 + 4	220 + 4	240 + 4	250 + 4	100 + 1	110 + 1
		50k-100k	500 + 10	550 + 10	600 + 10	600 + 10	300 + 10	330 + 10
		100k-300k	.15% + 110	.15% + 110	.16% + 110	.16% + 110	.15% + 110	.15% + 100
		300k-500k	.50% + 110	.52% + 110	.53% + 110	.54% + 110	.50% + 110	.52% + 110
		500k-1M	1.20% + 220	1.25% + 220	1.25% + 220	1.30% + 220	1.20% + 220	1.20% + 220
1100V	1 mV	50-1k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
5725A Amplifier:								
1100V	1 mV	40-1k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
		1k-20k	105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6
		20k-30k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
750V		30k-50k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
		50k-100k	600 + 45	.13% + 45	.16% + 45	.23% + 45	380 + 45	.12% + 45

AC Voltage (continued)

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient		Output Impedance	Maximum Distortion Bandwidth 10 Hz-10 MHz
			10°-40°C	0°-10°C and 40°-50°C		
	Hz	±μV	±μV/°C		Ω	±(% output + μV)
2.2 mV	10-20	5	.05	.05	50	.05 + 10
	20-40	5	.05	.05		.035 + 10
	40-20k	2	.05	.05		.035 + 10
	20k-50k	2	.1	.1		.035 + 10
	50k-100k	3	.2	.2		.035 + 10
	100k-300k	3	.3	.3		.3 + 30
	300k-500k	5	.4	.4		.3 + 30
	500k-1M	5	.5	.5		1 + 30
22 mV	10-20	5	.2	.3	50	.05 + 11
	20-40	5	.2	.3		.035 + 11
	40-20k	2	.2	.3		.035 + 11
	20k-50k	2	.4	.5		.035 + 11
	50k-100k	3	.5	.5		.035 + 11
	100k-300k	5	.6	.6		.3 + 30
	300k-500k	10	1	1		.3 + 30
	500k-1M	15	1	1		1 + 30
		±(ppm output + μV)	±(ppm output + μV)/°C			
220 mV	10-20	150 + 20	2 + 1	2 + 1	50	.05 + 16
	20-40	80 + 15	2 + 1	2 + 1		.035 + 16
	40-20k	12 + 2	2 + 1	2 + 1		.035 + 16
	20k-50k	10 + 2	15 + 2	15 + 2		.035 + 16
	50k-100k	10 + 2	15 + 4	15 + 4		.035 + 16
	100k-300k	20 + 4	80 + 5	80 + 5		.3 + 30
	300k-500k	100 + 10	80 + 5	80 + 5		.3 + 30
	500k-1M	200 + 20	80 + 5	80 + 5		1 + 30
					Load Regulation ±(ppm output + μV)	
2.2V	10-20	150 + 20	50 + 10	50 + 10	10 + 2	.05 + 80
	20-40	80 + 15	15 + 5	15 + 5	10 + 2	.035 + 80
	40-20k	12 + 4	2 + 1	5 + 2	10 + 4	.035 + 80
	20k-50k	15 + 5	10 + 2	15 + 4	30 + 10	.035 + 80
	50k-100k	15 + 5	10 + 4	20 + 4	80 + 16	.035 + 80
	100k-300k	30 + 10	80 + 15	80 + 15	300 ppm	.3 + 110
	300k-500k	70 + 20	80 + 40	80 + 40	600 ppm	.3 + 110
	500k-1M	150 + 50	80 + 100	80 + 100	.12%	1 + 110
22V	10-20	150 + 20	50 + 100	50 + 100	10 + 20	.05 + 700
	20-40	80 + 15	15 + 30	15 + 40	10 + 20	.035 + 700
	40-20k	12 + 8	2 + 10	4 + 15	10 + 30	.035 + 700
	20k-50k	15 + 10	10 + 20	20 + 20	30 + 50	.035 + 700
	50k-100k	15 + 10	10 + 40	20 + 40	80 + 80	.035 + 700
	100k-300k	30 + 15	80 + 150	80 + 150	100 + 700	.3 + 800
	300k-500k	70 + 100	80 + 300	80 + 300	200 + 1.1 mV	.3 + 800
	500k-1M	150 + 100	80 + 500	80 + 500	600 + 3.0 mV	1 + 800
220V	10-20	150 + 200	50 + 1 mV	50 + 1 mV	10 + .2 mV	.05 + 10 mV
	20-40	80 + 150	15 + 300	15 + 300	10 + .2 mV	.05 + 10 mV
	40-20k	12 + 80	2 + 80	4 + 80	10 + .3 mV	.05 + 10 mV
	20k-50k	15 + 100	10 + 100	20 + 100	30 + .6 mV	.05 + 10 mV
	50k-100k	15 + 100	10 + 500	20 + 500	80 + 3 mV	.1 + 13 mV
	100k-300k	30 + 400	80 + 600	80 + 600	250 + 25 mV	.5 + 50 mV
	300k-500k	100 + 10 mV	80 + 800	80 + 800	500 + 50 mV	1 + 50 mV
	500k-1M	200 + 20 mV	80 + 1 mV	80 + 1 mV	1000 + 110 mV	3 + 100 mV
		±(ppm output + mV)	±(ppm output)/°C			±(% output)
1100V	50-1k	10 + .5	2	5	10 + 1	.07

AC Voltage (continued)

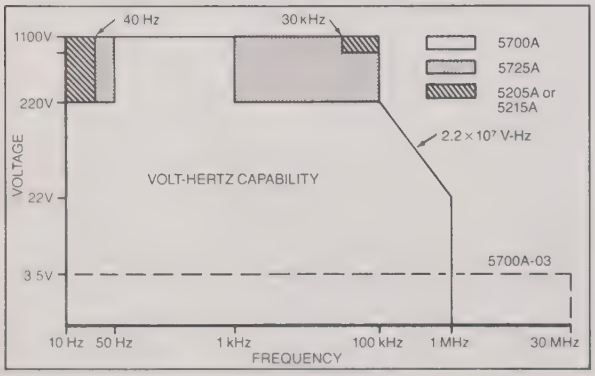
Secondary Performance and Operating Characteristics (continued)

Included in Uncertainty Specifications

5725A Amplifier:								
Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient		Load Regulation [Note 2]	Distortion Bandwidth 10 Hz-10 MHz		
			10°-40°C	0°-10°C and 40°-50°C				
	Hz	±(ppm output + mV)	±(ppm output)/°C		±(ppm output + mV)	±(% output)		
						150 pF	300 pF	1000 pF
1100V	40-1k	10 + .5	5	5	10 + 1	.07	.07	.07
	1k-20k	15 + 2	5	5	90 + 6	.10	.15	.20
	20k-50k	40 + 2	10	10	275 + 11	.30	.30	.50
	50k-100k	130 + 2	30	30	500 + 30	.40	.50	.50

Voltage Range	Maximum Current Limits [Note 1]		Load Limits
2.2V 22V 220V	50 mA, 0°C-40°C 20 mA, 40°C-50°C		>50Ω, 1000 pF
1100V	6 mA		600 pF
5725A Amplifier:			1000 pF [Note 2]
1100V	40 Hz-5 kHz	50 mA	300 pF
	5 kHz-30 kHz	70 mA	
	30 kHz-100 kHz		150 pF

Notes:
1. 2.2V Range, 100 kHz-1.2 MHz only: uncertainty specifications cover loads to 10 mA or 1000 pF. For higher loads, load regulation is added
2. The 5725A will drive up to 1000 pF of load capacitance. Uncertainty specifications include loads to 300 pF and 150 pF as shown under "Load Limits." For capacitances up to the maximum of 1000 pF, add "Load Regulation."



Output display formats: Voltage or dBm, dBm reference 600Ω.

Minimum output: 10% on each range

External sense: Selectable for 2.2V, 22V, 220V, and 1100V ranges; 5700A <100 kHz, 5725A <30 kHz

Settling time to full accuracy:

Frequency (Hz)	Settling time (seconds)
<120	7
120-120k	5
>120k	2

+1 second for amplitude or frequency range change; +2 seconds for 1100V range.

Overshoot: <10%

Common mode rejection: 140 dB, DC to 400 Hz

Frequency:
Range: 10 Hz to 1.1999 MHz
Uncertainty: ±0.01%
Resolution: 4½ digits

Phase lock: Selectable rear panel BNC input
Phase uncertainty (except 1100V range):
>30 Hz: ±(1° + 0.05°/kHz), <30 Hz: ±3°
Input voltage: 1V to 10V rms sine wave
Frequency range: 10 Hz to 1.1999 MHz
Lock range: ±2% of frequency
Lock-in time: Larger of 10/frequency or 10 msec

Phase reference: Selectable, rear panel BNC output
Range: ±180°
Phase Uncertainty (except 1100V range):
±1° at quadrature points (0°, ±90°, ±180°) elsewhere ±2°
Stability: ±0.1°
Resolution: 1°
Output level: 2.5V rms ±0.2V
Frequency range: 50 Hz to 1 kHz, useable 10 Hz to 1.1999 MHz

Resistance

Nominal Value	Absolute Uncertainty of Characterized Value ±5°C from calibration temperature [Note 1]				Relative Uncertainty ±1°C	
	24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
Ω	±ppm				±ppm	
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	85	95 .001%	100	110	32	40
1.9	85	95	100	110	25	33
10	26	28 .004%	30	33	5	8
19	24	26	28	31	4	7
100	15	17 .002%	18	20	2	4
190	15	17	18	20	2	4
1k	11	12 .001%	13	15	2	3.5
1.9k	11	12	13	15	2	3.5
10k	9	11 .001%	12	14	2	3.5
19k	9	11	12	14	2	3.5
100k	11	13 .001%	14	16	2	3.5
190k	11	13	14	16	2	3.5
1M	16	18 .002%	20	23	2.5	5
1.9M	17	19	21	24	3.5	6
10M	33	37 .004%	40	46	10	14
19M	43	47	50	55	20	24
100M	110	120 .002%	125	130	50	60

Secondary Performance Specifications and Operating Characteristics
Included in Uncertainty Specifications

Nominal Value	Stability ±1°C	Temperature Coefficient [Note 2]		Full Spec Load Range [Note 3]	Maximum Peak Current	Maximum Difference of Characterized to Nominal Value	Two-Wire Adder active compensation [Note 4]	
		10°-40°C	0°-10°C and 40°-50°C				Lead Resistance	
	24 Hours						0.1Ω	1Ω
Ω	±ppm	±ppm/°C		mA	mA	±ppm	±mΩ	
0	—	—	—	8-500	500	—	2	4
1	32	4	5	8-100	700	500	2	4
1.9	25	6	7	8-100	500	500	2	4
10	5	2	3	8-11	220	300	2	4
19	4	2	3	8-11	160	300	2	4
100	2	2	3	8-11	70	150	2	4
190	2	2	3	8-11	50	150	2	4
1k	2	2	3	1-2	22	150	10	15
1.9k	2	2	3	1-1.5	16	150	10	15
10k	2	2	3	100-500 μA	7	150	50	60
19k	2	2	3	50-250 μA	5	150	100	120
100k	2	2	3	10-100 μA	1	150		
190k	2	2	3	5-50 μA	500 μA	150		
1M	2.5	2.5	6	5-20 μA	100 μA	200		
1.9M	3.5	3	10	2.5-10 μA	50 μA	200		
10M	10	5	20	.5-2 μA	10 μA	300		
19M	20	8	40	.25-1 μA	5 μA	300		
100M	50	12	100	50-200 nA	1 μA	500		

Notes:

1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ, <80% RH to 30°C, <70% RH to 40°C, <60% RH to 50°C

2. Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operated more than 5°C from calibration temperature, or calibrated outside the range 19°C to 24°C. Two examples:
   a) Calibrate at 20°C: Temperature coefficient adder is not required unless operated below 15°C or above 25°C.
   b) Calibrate at 26°C: Add 2°C temperature coefficient adder. Additional temperature coefficient adder is *not* required unless operated below 21°C or above 31°C.

3. Refer to current derating factors table for loads outside of this range.

4. Active two-wire compensation may be selected for values less than 100 kΩ, with either the front panel *or the meter input terminals* as reference plane. Active compensation is limited to 11 mA load, and to 2V burden.

Current Derating Factors

Nominal Value	Value of Derating Factor K for Over or Under Current		
Ω	Two-Wire Comp $I<I_L$ (Note 1)	Four-Wire $I<I_L$ (Note 1)	Four-Wire $I_U<I<I_{MAX}$ (Note 2)
SHORT	4.4	300	—
1	4.4	300	4×10^{5}
1.9	4.4	160	1.5×10^{4}
10	4.4	30	1.6×10^{3}
19	4.4	16	3×10^{3}
100	4.4	3.5	1×10^{2}
190	4.4	1.8	1.9×10^{2}
1k	4.4	0.4	0.1
1.9k	4.4	0.21	0.19
10k	5000	50	2.0
19k	5000	26	3.8
100k	—	7.5	2×10^{5}
190k	—	4.0	3.8×10^{5}
1M	—	1.0	1.5×10^{4}
1.9M	—	0.53	2.9×10^{4}
10M	—	0.2	1×10^{3}
19M	—	0.53	1.9×10^{3}
100M	—	0.1	—

Notes:

1. For $I<I_L$, errors occur due to thermally generated voltages within the 5700A. Use the following equation to determine the error, and add this error to the corresponding UNCERTAINTY or STABILITY specification.

   Error = $K(I_L - I)/(I_L \times I)$

   Where: Error is in mΩ for all TWO-WIRE COMP values and FOUR-WIRE SHORT, and in ppm for the remaining FOUR-WIRE values.

   K is the constant from the above table;
   I and I_L are expressed in mA for SHORT to 1.9 kΩ;
   I and I_L are expressed in μA for 10 kΩ to 100 MΩ

2. For $I_U<I<I_{MAX}$ errors occur due to self-heating of the resistors in the 5700A. Use the following equation to determine the error in ppm, and add this error to the corresponding UNCERTAINTY or STABILITY specification.

   Error in ppm = $K(I^2 - I_U^2)$

   Where: K is the constant from the above table;
   I and I_U are expressed in mA for SHORT to 19 kΩ;
   I and I_U are expressed in μA for 100 kΩ to 100 MΩ

DC Current

Range	Resolution	Absolute Uncertainty ± 5°C from calibration temperature				Relative Uncertainty ± 1°C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	nA	± (ppm output + nA)				± (ppm output + nA)	
220 μA	.1	45 + 10	50 + 10	55 + 10	60 + 10	24 + 2	26 + 2
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10	24 + 2	26 + 2
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100	24 + 20	26 + 20
	μA	± (ppm output + μA)				± (ppm output + μA)	
220 mA	.1	55 + 1	60 + 1	65 + 1	70 + 1	26 + .2	30 + .2
2.2A [Note 1]	1	80 + 30	85 + 30	90 + 30	95 + 30	40 + 6	45 + 6
5725A Amplifier:							
11A	10	380 + 470	385 + 480	390 + 480	400 + 480	100 + 130	110 + 130

Secondary Performance Specifications and Operating Characteristics
Included in Uncertainty Specifications

Range	Stability ± 1°C	Temperature Coefficient [Note 2]		Compliance Limits	Burden Voltage Adder [Note 3]	Maximum Load For Full Accuracy [Note 4]	Noise	
	24 Hours	10°-40°C	0°-10°C and 40°-50°C				Bandwidth 0.1-10 Hz	Bandwidth 10-10 kHz
							pk-pk	RMS
	± (ppm output + nA)	± (ppm output + nA)/°C		V	± nA/V	Ω	ppm output + nA	nA
220 μA	5 + 1	1 + .40	3 + 1	10	.2	20k	6 + .9	.7
2.2 mA	5 + 5	1 + 2	3 + 10	10	.2	2k	6 + 5	7
22 mA	5 + 50	1 + 20	3 + 100	10	10	200	6 + 50	50
220 mA	8 + 300	1 + 200	3 + 1 μA	10	100	20	9 + 300	500
2.2A	9 + 700	1 + 2.5 μA	3 + 10 μA	3 [Note 5]	2 μA	2	12 + 1.5 μA	2.0 μA
5725A:	± (ppm output + μA)	± (ppm output + μA)/°C					ppm ouput + μA	μA
11A	25 + 100	20 + 75	20 + 75	4	0	4	15 + 70	100

Notes:

Maximum output from 5700A terminals is 2.2A. Uncertainty specifications for 220 μA and 2.2 mA ranges are increased by 1.3× when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Add to uncertainty specifications:
   ± 200 × I^2 ppm for >100 mA on 220 mA range
   ± 10 × I^2 ppm for >1A on 2.2A range

2. Temperature coefficient is an adder to uncertainty specifications. It does *not* apply unless operating more than ± 5°C from calibration temperature.

3. Burden voltage adder is an adder to uncertainty specifications that does *not* apply unless burden voltage is greater than 0.5V.

4. For higher loads, multiply uncertainty specification by:

$$1 + \frac{0.1 \times \text{actual load}}{\text{maximum load for full accuracy}}$$

5. 5700A compliance limit is 2V for outputs from 1A to 2.2A. 5725A Amplifier may be used in range-lock mode down to 0A.

Minimum output: 0 for all ranges, including 5725A.

Settling time to full accuracy: 1 second for μA and mA ranges; 3 seconds for 2.2A range; 6 seconds for 11A range; + 1 second for range or polarity change

Overshoot: <5%

AC Current

Range	Resolution	Frequency	Absolute Uncertainty ±5°C from calibration temperature				Relative Uncertainty ±1°C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	±(ppm output + nA)				±(ppm output + nA)	
220 µA	1 nA	10-20	650 + 30	700 + 30	750 + 30	800 + 30	450 + 30	500 + 30
		20-40	350 + 25	380 + 25	410 + 25	420 + 25	270 + 25	300 + 25
		40-1k	120 + 20	140 + 20	150 + 20	160 + 20	110 + 20	120 + 20
		1k-5k	650 + 1 µA	750 + 1 µA	800 + 1 µA	850 + 1µA	600 + 1 µA	650 + 1 µA
		5k-10k	.40% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4µA	.39% + 4 µA	.43% + 4 µA
2.2 mA	10 nA	10-20	650 + 50	700 + 50	750 + 50	800 + 50	450 + 50	500 + 50
		20-40	350 + 40	380 + 40	410 + 40	420 + 40	270 + 40	300 + 40
		40-1k	120 + 40	140 + 40	150 + 40	160 + 40	110 + 40	120 + 40
		1k-5k	650 + 2 µA	750 + 2 µA	800 + 2 µA	850 + 2 µA	600 + 2 µA	650 + 2 µA
		5k-10k	.4% + 4 µA	.44% + 4 µA	.46% + 4 µA	.48% + 4 µA	.38% + 4 µA	.42% + 4 µA
22 mA	100 nA	10-20	650 + 500	700 + 500	750 + 500	800 + 500	450 + 500	500 + 500
		20-40	350 + 400	380 + 400	410 + 400	420 + 400	270 + 400	300 + 400
		40-1k	120 + 400	140 + 400	150 + 400	160 + 400	110 + 400	120 + 400
		1k-5k	650 + 10 µA	750 + 10 µA	800 + 10 µA	850 + 10 µA	600 + 10 µA	650 + 10 µA
		5k-10k	.4% + 20 µA	.44% + 20 µA	.46% + 20 µA	.48% + 20 µA	.38% + 20 µA	.42% + 20 µA
		Hz	+(ppm output + µA)				+(ppm output + µA)	
220 mA	1 µA	10-20	650 + 5	700 + 5	750 + 5	800 + 5	450 + 5	500 + 5
		20-40	350 + 4	380 + 4	410 + 4	420 + 4	280 + 4	300 + 4
		40-1k	300 + 4	330 + 4	350 + 4	360 + 4	280 + 4	300 + 4
		1k-5k	700 + 50	750 + 50	800 + 50	850 + 50	650 + 50	750 + 50
		5k-10k	.4% + 100	.44% + 100	.46% + 100	.48% + 100	.38% + 100	.42% + 100
2.2A	10 µA	40-1k	600 + 40	650 + 40	700 + 40	750 + 40	600 + 40	650 + 40
		1k-5k	700 + 100	750 + 100	800 + 100	850 + 100	650 + 100	750 + 100
		5k-10k	.80% + 200	.90% + 200	.95% + 200	1.0% + 200	.75% + 200	.85% + 200
5725A Amplifier:								
11A	100 µA	40-1k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1k-5k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5k-10k	.3% + 750	.33% + 750	.35% + 750	.36% + 750	.28% + 750	.32% + 750

AC Current (continued)

Secondary Performance Specifications and Operating Characteristics

Included in Uncertainty Specifications

Range	Frequency	Stability ±1°C 24 Hours	Temperature Coefficient [Note 1]		Compliance Limits	Burden Voltage Adder [Note 2]	Maximum Resistive Load For Full Accuracy [Note 3]	Noise and Distortion
			10°-40°C	0°-10°C and 40°-50°C				Bandwidth 10 Hz-50 kHz <0.5V Burden
	Hz	±(ppm output + nA)	±(ppm output + nA)/μC		V rms	±μA/V	Ω	±(% output + μA)
220 μA	10-20	100 + 5	50 + 5	50 + 5	7	.05	10k	.05 + .1
	20-40	80 + 5	20 + 5	20 + 5				.05 + .1
	40-1k	30 + 3	4 + .5	10 + .5				.05 + .1
	1k-5k	50 + 20	10 + 1	20 + 1		.5		.25 + .5
	5k-10k	400 + 100	20 + 100	20 + 100		5		.5 + 1
2.2 mA	10-20	100 + 5	50 + 5	50 + 5	7	.05	2k	.05 + .1
	20-40	80 + 5	20 + 4	20 + 4				.05 + .1
	40-1k	30 + 3	4 + 1	10 + 2				.05 + .1
	1k-5k	50 + 20	10 + 100	20 + 100		.5		.25 + .5
	5k-10k	400 + 100	50 + 400	50 + 400		5		.5 + 1
22 mA	10-20	100 + 50	50 + 10	50 + 10	7	.3	200	.05 + .1
	20-40	80 + 50	20 + 10	20 + 10				.05 + .1
	40-1k	30 + 30	4 + 10	10 + 20				.05 + .1
	1k-5k	50 + 500	10 + 500	20 + 400		5		.25 + .5
	5k-10k	400 + 1 μA	50 + 1 μA	50 + 1 μA		50		.5 + 1
	Hz	±(ppm output + μA)	±(ppm output + μA)/°C					±(% output)
220 mA	10-20	100 + .5	50 + .05	50 + .05	7	3	20	.05
	20-40	80 + .5	20 + .05	20 + .05				.05
	40-1k	30 + .3	4 + .1	10 + .1				.05
	1k-5k	50 + 3	10 + 2	20 + 2		50		.25
	5k-10k	400 + 5	50 + 5	50 + 5		500		.5
2.2A	40-1k	50 + 5	4 + 1	10 + 1	2 [Note 4]	30	2	.05
	1k-5k	80 + 20	10 + 5	20 + 5		500		.3
	5k-10k	800 + 50	50 + 10	50 + 10		5 mA		1
5725A Amplifier:								
11A	40-1k	75 + 100	20 + 75	20 + 75	3	—	3	.05
	1k-5k	100 + 150	40 + 75	40 + 75		—		.25
	5k-10k	200 + 300	100 + 75	100 + 75		—		.5

Notes:

Maximum output from 5700A terminals is 2.2A. Uncertainty specifications for 220 μA and 2.2 mA ranges are increased by 1.3× when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operating more than ±5°C from calibration temperature.

2. Burden voltage adder is an adder to uncertainty specifications that does *not* apply unless burden voltage is greater than 0.5V.

3. For larger resistive loads multiply uncertainty specifications by:

$$1 + \text{frequency in kHz} \times \left(\frac{\text{actual load}}{\text{maximum load for full accuracy}}\right)^2$$

4. 1.5V compliance limit above 1A. 5725A Amplifier may be used in range-lock mode down to 1A.

Minimum output: 9 μA for 220 μA range, 10% on all other ranges.

Inductive load limits: 400 μH (5700A or 5725A).

Power factors: 5700A, 0.9 to 1; 5725A, 0.1 to 1. Subject to compliance voltage limits.

Frequency uncertainty: ±0.01%

Settling time to full accuracy: 5 seconds for 5700A ranges; 6 seconds for 5725A 11A range; +1 second for amplitude or frequency range or polarity change

Overshoot: <10%

Wideband AC Voltage (Option -03)

Specifications apply to the end of the cable and 50Ω termination used for calibration:

Range		Resolution	Absolute Uncertainty ±5°C from calibration temperature 30 Hz-500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			±(% output + μV)			
1.1 mV	−46	10 nV	.2+.4	.4+.4	.6+.4	.8+2
3 mV	−37	10 nV	.2+1	.35+1	.5+1	.7+3
11 mV	−26	100 nV	.2+4	.35+4	.5+4	.7+8
33 mV	−17	100 nV	.2+10	.3+10	.45+10	.6+16
110 mV	−6.2	1 μV	.2+40	.3+40	.45+40	.6+40
330 mV	+3.4	1 μV	.2+100	.25+100	.35+100	.5+100
1.1V	+14	10 μV	.2+400	.25+400	.35+400	.5+400
3.5V	+24	10 μV	.15+500	.2+500	.3+500	.4+500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference Voltage Range			Temperature Coefficient	Settling Time To Full Accuracy	Harmonic Distortion
		1.1 mV	3 mV	>3 mV			
Hz	Hz	±%			±ppm/°C	Seconds	dB
10-30	.01	.3	.3	.3	100	5	−40
30-120	.01	.1	.1	.1	100	5	−40
120-1.2k	.1	.1	.1	.1	100	5	−40
1.2k-12k	1	.1	.1	.1	100	5	−40
12k-120k	10	.1	.1	.1	100	5	−40
120k-1.2M	100	.2+3 μV	.1	.1	100	5	−40
1.2M-2M	100k	.2+3 μV	.1	.1	100	0.5	−40
2M-10M	100k	.2+3 μV	.3	.2	100	0.5	−40
10M-20M	1M	.2+3 μV	.5	.4	150	0.5	−34
20M-30M	1M	1.5+15 μV	1.5	1	300	0.5	−34

Additional Operating Information:

dBm reference = 50Ω

Range boundaries are at voltage points, dBm levels are approximate.

$$dBm = 10 \log \left(\frac{Power}{1\ mW} \right),$$

for 50Ω: 0 dBm = 1 mW across 50Ω = 0.22361V

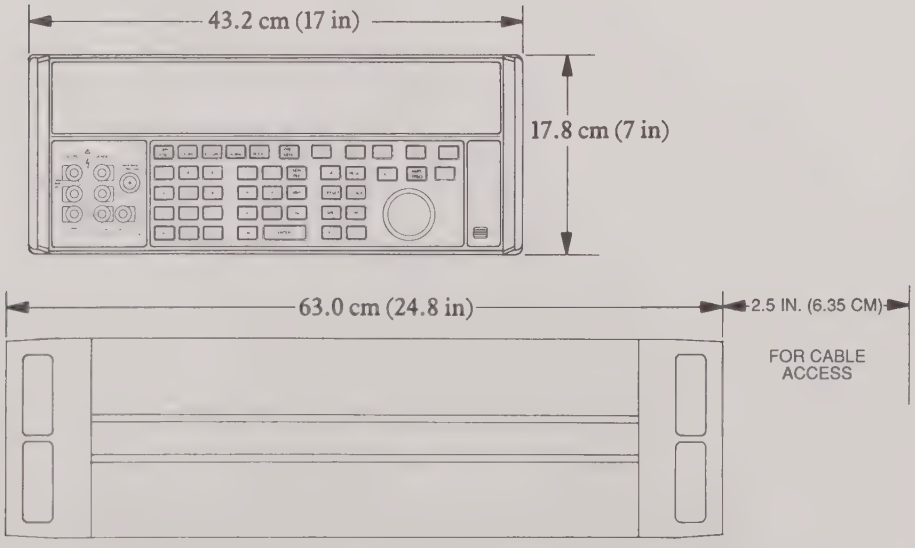
Minimum output: 300 μV (−57 dBm)

Frequency uncertainty: ±0.01%

Overload protection: A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

General Specifications:

Warm-up time: 2× the time since last warmed up, to a maximum of 30 minutes.
System installation: Rear output configuration and rack-mount kit available.
Standard interfaces: IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).
Temperature performance: Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: −40°C to 75°C
Relative humidity: Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage: <95%, non-condensing
Safety: Designed to comply with UL1244 (1987); IEC 348-1978; IEC 66E (CO) 4; CSA 556B.
Guard isolation: 20 volts
EMI/RFI: Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B.
Reliability: MIL-T-28800D, para. 3.13.3.
Line Power: 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V. Maximum power: 5700A, 300VA; 5725A, 750VA.
Size:
5700A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 63.0 cm (24.8 in), overall; 57.8 cm (22.7 in), rack depth.
5725A: Height 13.3 cm (5.25 in); Width and depth same as 5700A. Both units project 5.1 cm (2 in) from rack front
Weight: 5700A: 27kg (62 lbs); 5725A: 32kg (70 lbs).



Section 2
Installation

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WARNING

THE 5700A CALIBRATOR CAN SUPPLY LETHAL VOLTAGES TO THE FRONT AND REAR BINDING POSTS. READ THIS SECTION BEFORE OPERATING THE CALIBRATOR.

INTRODUCTION 2-1.

This section provides instructions for unpacking and installing the 5700A. The procedures for line voltage selection, fuse replacement, and connection to line power are provided here. Read this section before operating the 5700A.

Instructions for cable connections other than line power connection can be found in the following sections of the manual:

- UUT (Unit Under Test) connections: Section 4
- IEEE-488 interface bus connection: Section 5
- RS-232-C serial interface connection: Section 6
- Option 5700-03 Wideband AC Module connection: Section 4
- Auxiliary amplifier connections: Section 4

UNPACKING AND INSPECTION 2-2.

The 5700A is shipped in a container designed to prevent damage during shipping. Inspect the 5700A carefully for damage, and immediately report any damage to the shipper. Instructions for inspection and claims are included in the shipping container.

When you unpack the 5700A, check for all the standard equipment listed in Table 2-1 and check the shipping order for any additional items ordered. Refer to Section 8 for information about options and accessories. Report any shortage to the place of purchase or to the nearest Fluke Technical Service Center. (A List of Fluke Technical Service Centers is located in Appendix E of this manual.) If performance tests are required for your acceptance procedures, refer to the 5700A Service Manual for instructions.

If you need to reship the 5700A, use the original container. If it is not available, you can order a new container from Fluke by indicating the 5700A's model and serial number.

Table 2-1. Standard Equipment

ITEM	MODEL OR PART NUMBER
Calibrator	5700A
Line Power Cord	See Table 2-2 and Figure 2-2
5700A Getting Started Guide	791962
5700A Operator Manual	791905
5700A Operator Reference Guide	813568
5700A Remote Programming Reference Guide	813550
5700A Service Manual	791996
Certificate of Calibration	(None)

SERVICE INFORMATION 2-3.

Each Model 5700A Calibrator is warranted to the original purchaser for a period of one year beginning on the date received. The warranty is located at the front of this manual.

Factory-authorized service and technical advice for the 5700A is available at Fluke Technical Service Centers. Appendix E contains a list of addresses and telephone numbers for all Fluke Technical Service Centers.

After-warranty service is available, but you may choose to repair the 5700A using the information in the Troubleshooting Section of the 5700A Service Manual and the Module Exchange Program. Refer to the Fluke catalog or contact a Technical Service Center representative for the module exchange procedure.

PLACEMENT AND RACK MOUNTING 2-4.

You can use the 5700A on top of a bench or mounted in a standard-width, 24-inch (61-cm) deep equipment rack. For bench-top use, the 5700A is equipped with non-slipping, non-marring feet. To mount the 5700A in an equipment rack, use the 5700A Rack Mount Kit, Model Y5737. Instructions for rack mounting the 5700A are packed in the box with the rack mount kit. For convenience, you can insert the rack mount instruction sheet in this binder after the Data Sheets tab divider.

CAUTION

Use only the rack mount slides included in the Y5737 kit. Rack mount slides for other instruments can block the side ventilation holes on the 5700A, causing overheating.

COOLING CONSIDERATIONS 2-5.

CAUTION

Damage caused by overheating may occur if the area around the air intake is restricted, the intake air is too warm, or the air filter becomes clogged.

A hidden but important feature of the 5700A is its internal cooling system. Baffles direct cooling air from the fans throughout the chassis to internally dissipate heat during operation. The accuracy and dependability of all internal parts of the 5700A are enhanced by maintaining the coolest possible internal temperature. By observing the following rules, you can lengthen the life of the 5700A and enhance its performance:

- The area around the air filter must be at least 3 inches from nearby walls or rack enclosures.
- The exhaust perforations on the sides of the 5700A must be clear of obstructions.
- The air entering the instrument must be room temperature. Make sure that exhaust from another instrument is not directed into the fan inlet.
- Clean the air filter every 30 days or more frequently if the 5700A is operated in a dusty environment. (Instructions for cleaning the air filter are in Section 7.)

ACCESSING THE FUSE 2-6.

CAUTION

To prevent instrument damage, verify that the correct fuse is installed for the line voltage setting.

The line power fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder (labeled F1) shows the correct replacement fuse rating for each line voltage setting. To check or replace the fuse, refer to Figure 2-1 and proceed as follows:

1. Disconnect line power.
2. Insert the blade of a standard screwdriver in the slot of the fuse holder labeled F1.
3. Turn the screwdriver counterclockwise until the cap and fuse pop free.
4. To reinstall the fuse, reverse this procedure.

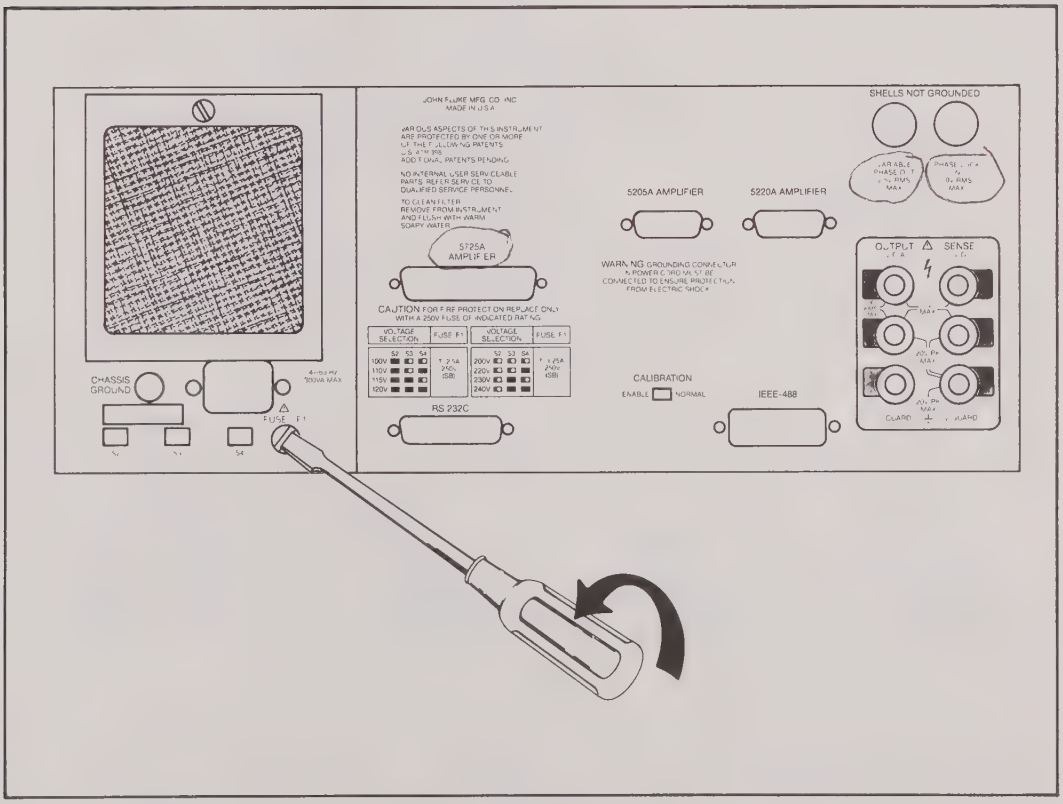

Figure 2-1. Accessing the Fuse

SELECTING LINE VOLTAGE 2-7.

The 5700A arrives from the factory configured for the line voltage normally appropriate for the country of purchase, or as specified at the time of your purchase order. The 5700A also comes with the appropriate line power plug for the country of purchase. If you need a different type, refer to Table 2-2 and Figure 2-2. They list and illustrate the line power plug types available from Fluke.

Check the line power label on the rear panel of the 5700A to verify that the line voltage matches local line power. Figure 2-3 shows the location of the line power label.

You can set the 5700A to operate from eight different nominal line voltages; each voltage setting has an allowed voltage tolerance of ±10% and frequency range of 47 to 63 Hz. The line voltage switches are located on the bottom left side of the rear panel.

To change the line voltage setting, set the line voltage selection switches to the correct setting shown in Figure 2-3.

Table 2-2. Line Power Cord Types Available from Fluke

TYPE	VOLTAGE/CURRENT	FLUKE OPTION NUMBER
North America	120V/15A	LC-1
North America	240V/15A	LC-2
Universal Euro	220V/16A	LC-3
United Kingdom	240V/13A	LC-4
Switzerland	220V/10A	LC-5
Australia	240V/10A	LC-6
South Africa	240V/5A	LC-7

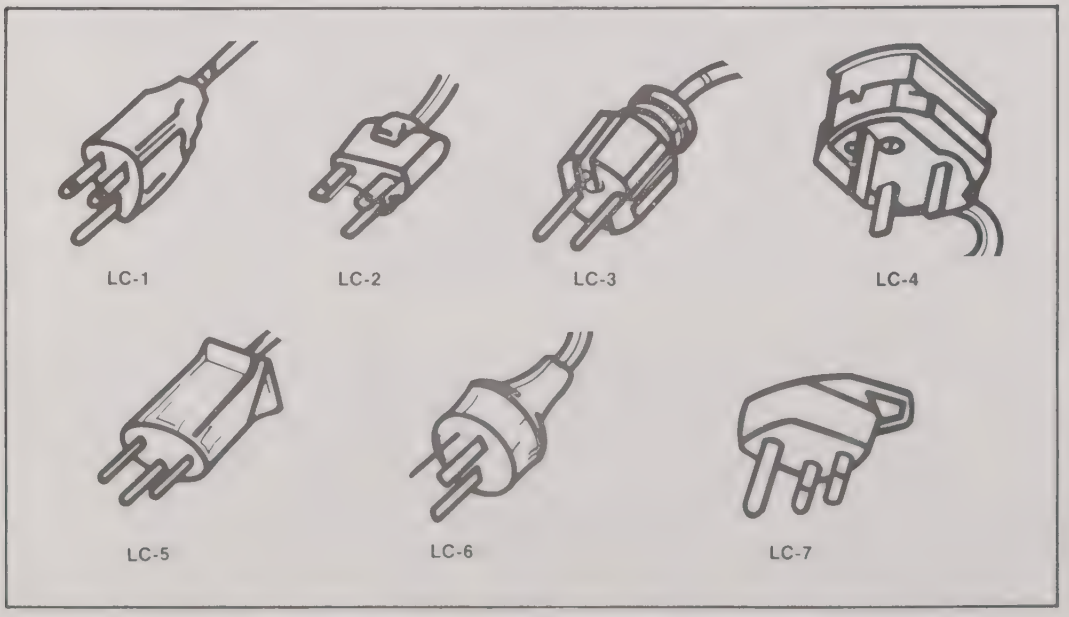

Figure 2-2. Line Power Cord Types Available from Fluke

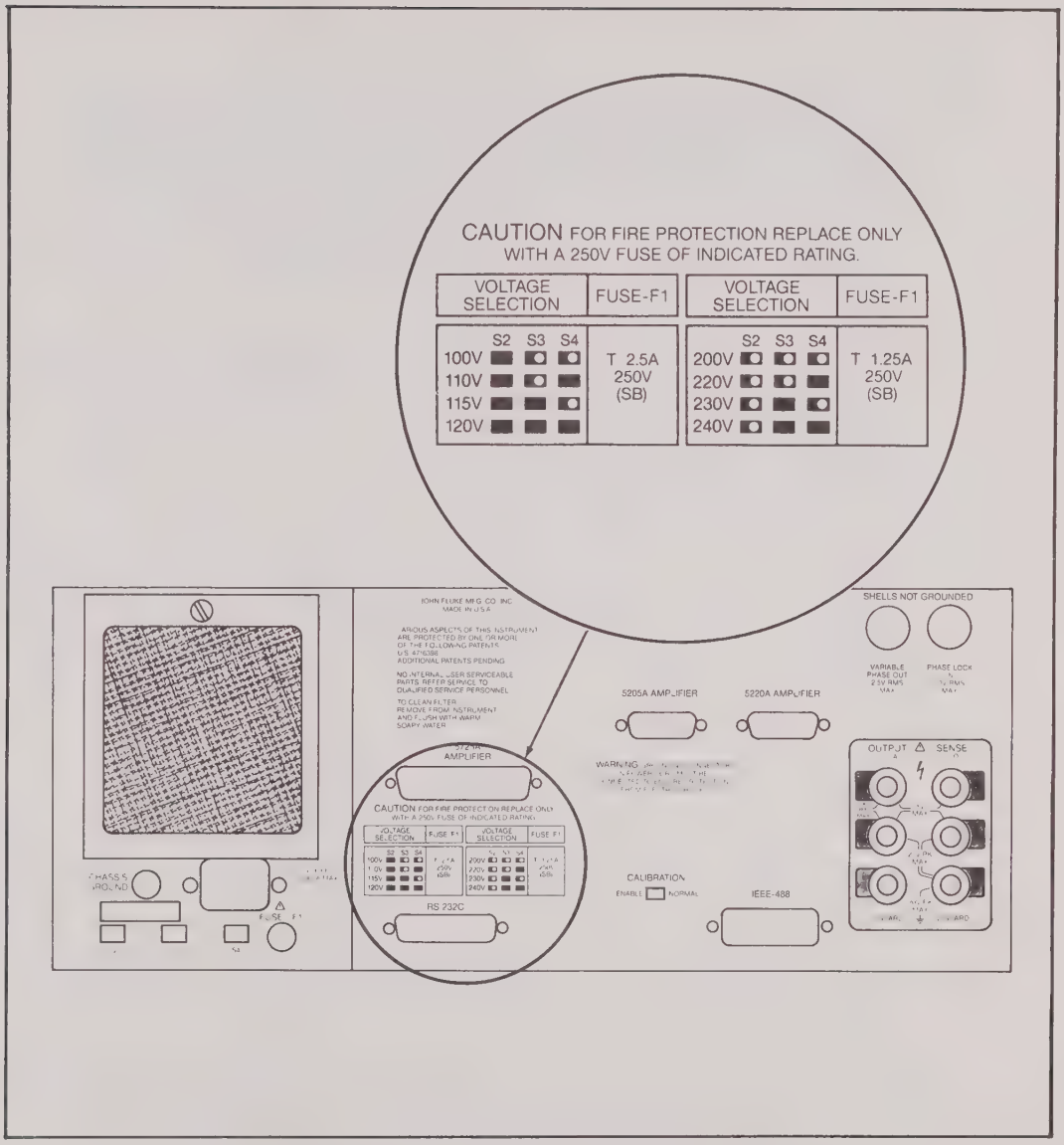

Figure 2-3. Line Power Label and Switch Location

CONNECTING TO LINE POWER 2-8.

WARNING

TO AVOID SHOCK HAZARD, CONNECT THE FACTORY SUPPLIED THREE-CONDUCTOR LINE POWER CORD TO A PROPERLY GROUNDED POWER OUTLET. DO NOT USE A TWO-CONDUCTOR ADAPTER OR EXTENSION CORD; THIS WILL BREAK THE PROTECTIVE GROUND CONNECTION.

IF A TWO-CONDUCTOR POWER CORD MUST BE USED, A PROTECTIVE GROUNDING WIRE MUST BE CONNECTED BETWEEN THE GROUND TERMINAL AND EARTH GROUND BEFORE CONNECTING THE POWER CORD OR OPERATING THE INSTRUMENT.

After you verify that the line voltage selection switches are set to the correct positions, verify that the correct fuse for that line voltage is installed. Connect the 5700A to a properly grounded three-prong outlet.

CONNECTING AUXILIARY AMPLIFIERS 2-9.

The 5700A provides interface connectors for three Fluke amplifiers: Models 5725A, 5205A or 5215A, and 5220A. You can connect amplifiers to all three 5700A amplifier interface connectors at once, although only one amplifier can be active at a time. You designate the active amplifier for voltage and current boost in a setup menu. That procedure is located in the beginning of Section 4. For all amplifiers, one cable provides the complete link for analog and digital control signals.

Connecting a 5725A Amplifier 2-10.

Refer to the 5725A Instruction Manual for its installation procedure.

Connecting a 5205A or 5215A Precision Power Amplifier 2-11.

Proceed as follows to connect a Model 5205A or 5215A Precision Power Amplifier to the 5700A:

1. Turn the amplifier and 5700A power off and disconnect both power cords from the line power receptacles.

2. Connect the Accessory Y5701 Interface Cable to the amplifier rear panel connector labeled 5200A. This connector is located on the lower middle area of the rear panel.

3. Connect the other end of the interface cable to the 5700A rear panel connector labeled 5205A. This is the correct connector for both the 5205A and the 5215A.

Connecting a 5220A Transconductance Amplifier 2-12.

1. Turn the amplifier and 5700A power off and disconnect both power cords from the line power receptacles.

2. Attach the interconnect shield plate that is shipped with the Y5702 Interconnect Cable Assembly to the 5220A rear panel as described in the instruction sheet packed with the Y5702.

3. Connect the other end of the interface cable to the 5700A rear panel connector labeled 5225A.

SELECTING OUTPUT BINDING POSTS 2-13.

The 5700A is equipped with binding posts for OUTPUT, SENSE, and V GUARD (Voltage Guard) on the front and rear panels. Only one set of binding posts can be enabled at the same time. (GND binding posts on both front and rear are always connected to chassis ground.) The 5700A is shipped with the front panel binding posts enabled. The procedure to enable the rear panel binding posts involves opening the case of the 5700A, and repositioning a cable. This procedure is described in Section 4 of the the 5700A Service Manual.

NOTE

A Type "N" connector for output from the Option 5700-03 Wideband AC Voltage Module is available only on the 5700A front panel. A terminal for I GUARD is available only on the rear panel. (Connection to the I GUARD terminal is normally required only at low current levels in calibration systems with long cable runs.) Sections 3 and 4 contain detailed information about the function and use of all binding posts.

Section 3
Features

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INTRODUCTION 3-1.

This section is a reference for the functions and locations of the 5700A Calibrator's front and rear panel features. Please read this information before operating the calibrator. Front panel operating instructions for the calibrator are provided in Section 4, and remote operating instructions are provided in Section 5.

FRONT PANEL FEATURES 3-2.

Front panel features (including all controls, displays, indicators, and terminals) are shown in Figure 3-1. Each front panel feature is described in Table 3-1.

REAR PANEL FEATURES 3-3.

Rear panel features (including all terminals, sockets, and connectors) are shown in Figure 3-2. Each rear panel feature is described in Table 3-2.

SOFTKEY MENU TREE 3-4.

The softkeys are identified in Figure 3-1 and Table 3-1. The functions of the six softkeys are identified by label information displayed directly above each key. The softkey labels change during operation so that many different functions are quickly accessible.

A group of softkey labels is called a menu. A group of interconnected menus is called a menu tree. Figure 3-3 shows the menu tree for the calibrator.

Table 3-1. Front Panel Features

① **Output Display**

A two-line vacuum-fluorescent display that shows output amplitude and frequency. The top line shows the active output value (or potential output value if in standby) in up to eight digits plus a polarity sign. The bottom line shows output frequency (or potential output frequency if the 5700A is in standby) in five digits. Following the digits on both lines of the Output Display are four unit annunciators. (Examples of units are: mV, μA, and kHz.) Annunciators below the amplitude line on the Output Display indicate the following active conditions:

OPERATE	Lit when an output is active at the binding posts or auxiliary amplifier
STANDBY	Lit when the 5700A is in standby
ADDR	Lit when the 5700A is addressed over the IEEE-488 interface
ΦLCK	Lit when the 5700A output is phase locked to a signal at the rear panel PHASE LOCK IN connector
ΦSHF	Lit when the 5700A output has a programmed phase difference with a signal at the rear panel VARIABLE PHASE OUT connector
U	(Unsettled.) When you change the output, this annunciator lights for a second or two until the output settles to within specification.

② **Control Display**

A multi-purpose alphanumeric vacuum-fluorescent display that shows data entries, UUT error adjustments, softkey labels, and other prompts and messages. Softkey labels identify the function of the softkey directly below them. Several softkey labels together are called a menu. The changing menus provide access to many different functions through the five softkeys plus the PREV MENU key. (See Figure 3-3, Softkey Menu Tree.)

③ OPR/STBY **(Operate/Standby)**

Toggles the 5700A between operate and standby modes. In standby mode, the OUTPUT binding posts are internally disconnected from the 5700A. The 5700A normally starts up in standby. Status is indicated by the lighted OPERATE or STANDBY annunciator above the OUTPUT binding posts. Pressing the OPR/STBY key does not change any other 5700A status.

The 5700A automatically switches to standby when any of the following events occur:

- The RESET key is pressed.
- A voltage ≥ 22V is selected when the previous output voltage was less than 22V.
- Output function is changed between voltage, current, or resistance.
- The output location is changed, for example by selecting an amplifier.

④ EX SNS **(External Sense)**

Opens and closes an internal connection between the SENSE and OUTPUT binding posts. The 5700A powers up with SENSE and OUTPUT connected internally (the SENSE binding posts are open circuited) and the EX SNS indicator off. Pressing EX SNS disconnects the sense lines from the OUTPUT binding posts, connects them to the SENSE binding posts internally, and lights the EX SNS indicator.

External Sensing should be used in the dc voltage function when the UUT draws enough current to produce a significant voltage drop in the cables, and in the resistance function when the UUT has a four-wire ohms input and the 5700A is set to 100 kΩ or less. External sensing can also be used in the two-wire ohms function to activate two-wire compensation circuitry to the UUT terminals. Refer to "When to use External Sensing," "Four-Wire VS Two-Wire Resistance Connections," and "Cable Connections" in Section 4 for external sensing instructions and illustrations of SENSE connections.

Table 3-1. Front Panel Features (cont)

⑤	**EX GRD (External Guard)** Opens and closes an internal connection between the V GUARD (voltage guard) and OUTPUT LO. The 5700A powers up with the voltage guard internally connected to OUTPUT LO and the EX GRD indicator off. Pressing the EX GRD key disconnects OUTPUT LO from the voltage guard and lights the indicator. The V GUARD binding post provides an external connection point for the voltage internal guard. For a UUT with floating (ungrounded) inputs, the V GUARD should be connected to LO internally. (The EX GRD key is toggled so that the indicator is off.) For a UUT with a grounded input, the GUARD may be externally connected to the grounded UUT input. (The EX GRD key is toggled so that the EX GRD indicator is lit.) Refer to "When to use External Voltage Guard" and "Cable Connections" in Section 4 for instructions and an illustration of V GUARD connections.
⑥	**W BND (Wideband)** Enables and disables the Option 5700A-03 Wideband AC Voltage Module and sets the 5700A to standby mode. When enabled, the W BND indicator lights and ac voltage output over the range of 10 Hz to 30 MHz is available at the front-panel coaxial connector. The wideband function is disabled whenever W BND is specifically de-selected or when another function (such as current) is selected. Refer to Section 4 for connecting and operating instructions for the wideband module.

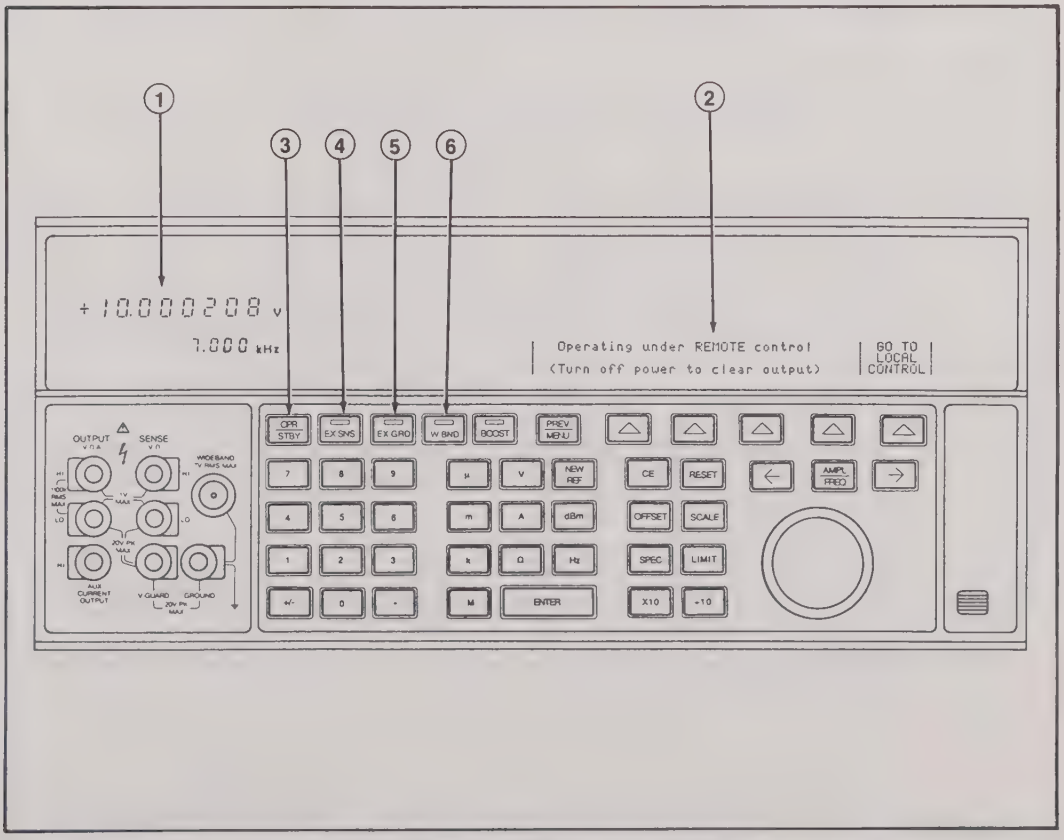


Figure 3-1. Front Panel Features

Table 3-1. Front Panel Features (cont)

⑦ BOOST

Enables or disables output from an amplifier, when it would not otherwise be automatically selected. Sets the 5700A to standby if this selection moves the output location.

When available, an amplifier is automatically selected for output settings that exceed 5700A capabilities but fall within the limits of the selected amplifier. The BOOST key is only needed to activate an amplifier for an output setting that is available from either the 5700A or the amplifier. This allows you to take advantage of amplifier capabilities besides extended range, such as higher compliance voltage.

For both voltage and current, the amplifier is assumed to be a 5725A unless another model is designated in the setup menus.

⑧ PREV MENU **(Previous Menu)**

The PREV MENU (Previous Menu) recalls the previous set of menu choices. Some menus display a more specific label for this key, such as "DONE Setting Up".

⑨ **Softkeys**

The functions of the five unlabeled softkeys are identified by labels on the Control Display directly above each key. The functions change during operation so that many different functions are accessible through these keys. A group of softkey labels is called a menu. A group of interconnected menus is called a menu tree. Figure 3-3 shows the menu tree for the 5700A.

⑩ **Power Switch**

Turns the power on and off. The switch is a push-push type; the first push turns the power on and locks the switch in, and the second push turns the power off and releases the switch.

⑪ ← AMPL FREQ →

The output adjustment controls. If any of these keys are pressed or the knob is rotated, a digit on the and Rotary Knob output display becomes highlighted and the output increments or decrements as the knob is rotated. If a digit rolls past 0 or 9, the digit to its left or right is carried. An error display appears on the Control Display, showing the difference between the original (reference) output and the new (adjusted) output.

The ← and → keys adjust the magnitude of changes by moving the highlighted digit. In the ac functions, the AMPL/FREQ key allows you to move from voltage or current to frequency and back. In practice, for voltage and current outputs, the knob and arrow keys are used to adjust output until the UUT reads correctly. The error display then displays UUT deviation from the reference.

Since resistances are not adjustable, the the knob and arrow keys adjust a value on the Control Display to equal the UUT reading. Refer to "Error Mode Operation" in Section 4 for details of entering, operating, and exiting Error Mode.

The rotary knob is also used to adjust the phase of the ac output signal with respect to a signal at the VARIABLE PHASE OUT connector after the "Phase Ctrls Menu" softkey is pressed.

⑫ RESET

Aborts the current operating state of the 5700A and returns the 5700A to the power-up default state. RESET works in all cases except when operating under remote control.

Table 3-1. Front Panel Features (cont)

⑬	SCALE	Identifies a UUT full-scale endpoint for checking linearity and does not change the output. If the output was adjusted with the rotary knob, subsequent keyed-in output values are multiplied by a scale factor. Scaling is deactivated by pressing SCALE again, or by selecting another function. Scaling is not available for resistance outputs. See "Linearity Checking Using Offset and Scale" in Section 4 for details.
⑭	LIMIT	Calls up a menu that allows you to specify limits beyond which the 5700A will not operate, to protect your test equipment and personnel.
⑮	÷10	Immediately changes the output to one tenth the reference value (not necessarily the present output value) if the value is within performance limits.
⑯	X 10	Immediately changes the output to ten times the reference value (not necessarily the present output value) if the value is within performance limits. This key sets the 5700A to standby if this change is from below 22V to 22V or more.

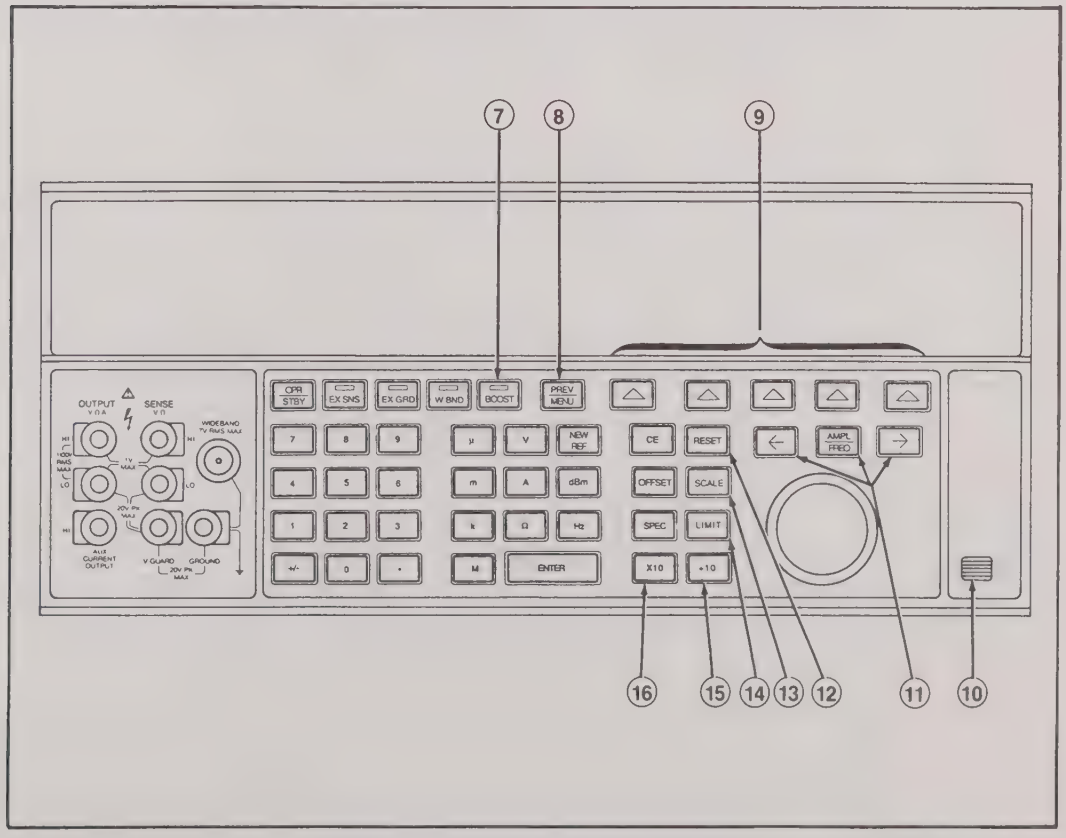


Figure 3-1. Front Panel Features (cont)

Table 3-1. Front Panel Features (cont)

⑰ [SPEC] **(Specification)**

Causes the 5700A to compute and display 5700A absolute uncertainty for the present output setting for the calibration interval selected in the setup menus.

⑱ [OFFSET]

Identifies a UUT zero-scale endpoint and does not change the output. Subsequent keyed-in output values have the offset value (the 5700A output value when OFFSET was pressed) added to them. Offset mode is deactivated by pressing OFFSET again or by selecting another function. Offsets are available for dc outputs only. See "Programming an OFFSET" in Section 4 for details.

⑲ [CE] **(Clear Entry)**

Clears a partially completed keypad entry from the Control Display or clears an error message that requires acknowledgement. If there is a partially completed entry when CE is pressed, the output is unaffected.

⑳ [NEW REF]

Only active during error mode operation, the NEW REF key establishes the present output value as a new reference for meter error computation.

㉑ [dBm]

When in the ac volts or wideband function, and if no entry is in progress, the dBm key shows the equivalent dBm output on the Control Display. For the ac voltage function, dBm is calculated for a 600Ω load. For the wideband function, dBm is calculated for a 50Ω resistive termination at the end of a 3-foot 50Ω coaxial cable. The V key works similarly when units of dBm are in use.

NOTE

*The formula to compute dBm is: 10 * log (power in mW)*
Examples: For 3.0V into a 600Ω load, dBm = 10 log (15.000) = 11.7609 dBm
For 3.0V into a 50Ω load, dBm = 10 log (180.000) = 22.5527 dBm

㉒ [ENTER]

The ENTER key loads a newly entered output value showing on the Control Display into the 5700A. The new value can come from the numeric keypad. If you press ENTER without identifying the units for the entry, the 5700A keeps the units that were last used. This allows you, for example, to enter 1 mV, and then later simply enter 10 to obtain 10V. (The "V" units were saved from the last entry, but not the multiplier, "m".)

Another function of the ENTER key is to recall the currently-programmed reference value in error mode operation. Refer to "Error Mode Operation" in Section 4 for details.

㉓ **Output Function Keys**

Select the output function. The output functions are:

[dBm]	Decibels relative to 1 mW
V	Voltage
[A]	Current
[Ω]	Resistance
[Hz]	Frequency

When Hz is entered, the 5700A automatically switches to ac. When a new signed (+ or -) output value is entered without specifying Hz, the 5700A automatically switches back to dc.

Table 3-1. Front Panel Features (cont)

(24) Multiplier Keys

Select output value multipliers. For example, if you enter 33, then m, then V, then ENTER, the 5700A output value is 33 mV. The multiplier keys are:

μ	micro (10^{-6} or 0.000001)
m	milli (10^{-3} or 0.001)
k	kilo (10^{3} or 1,000)
M	mega (10^{6} or 1,000,000)

(25) Numeric Keypad

Used to enter the digits of the output amplitude and frequency, as well as other data such as the time and date. The proper sequence to enter a value is to press the digits of the output value, a multiplier key (if necessary), an output function key, then ENTER. For example, to obtain an output of 20 mV, you would press the following sequence of keys: 2 0 m V ENTER.

(26) +/-

If the output function is dc voltage, current, ac voltage entered in dBm, or a wideband output entered in dBm, pressing +/- then ENTER toggles the polarity of the output. If the output function is ac voltage or current, pressing +/- then ENTER changes the output to dc.

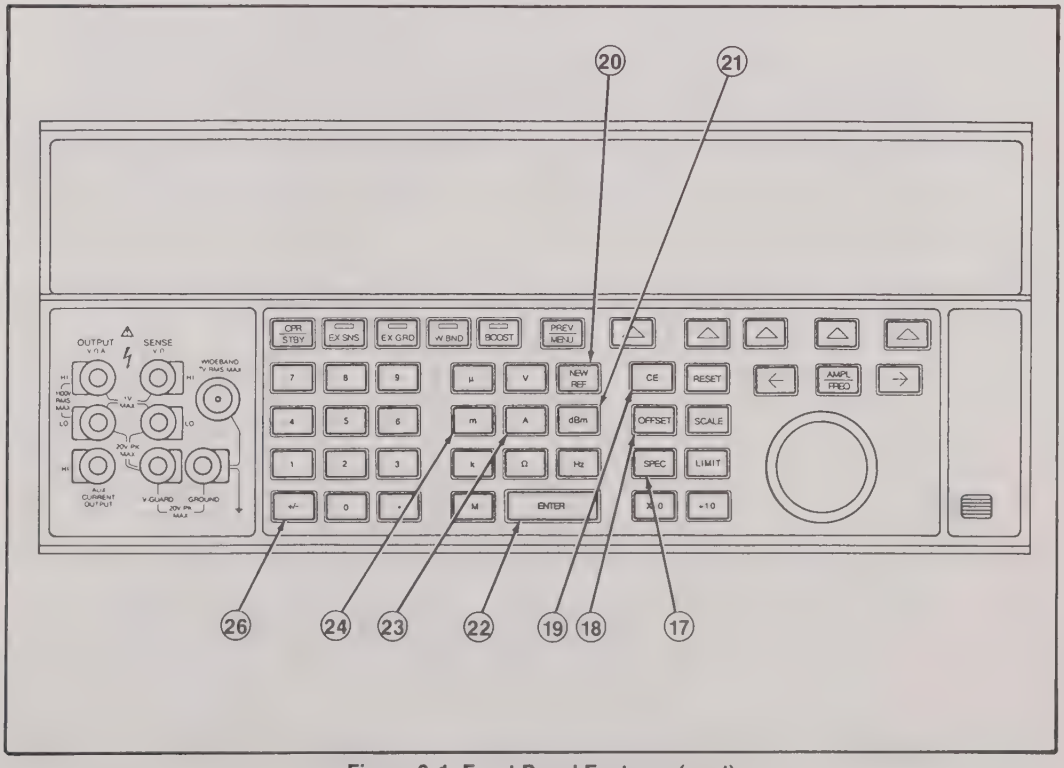


Figure 3-1. Front Panel Features (cont)

Table 3-1. Front Panel Features (cont)

㉗ **WIDEBAND Connector**

A Type "N" connector that provides a connection point for output from the Option 5700A-03 Wideband AC Module. Wideband output specifications are stated for output levels present at the end of its 3-foot 50Ω coaxial cable terminated into a 50Ω purely resistive load. The connector shell is connected to chassis ground. Refer to Section 4 for connecting and operating instructions for the wideband module.

㉘ **GND Binding Post**

If the 5700A is the location of the ground reference point in a system, the GND binding post can be used for connecting other instruments to earth ground. (The chassis is normally connected to earth ground through the three-conductor line cord instead of through the earth ground binding post.) Refer to "Cable Connections" in Section 4 for details. Included with the 5700A is a brass strap that connects GND to V GUARD.

㉙ **V GUARD Binding Post**

Provides an external connection point for the internal voltage guard. For a UUT with floating (ungrounded) inputs, the V GUARD should be connected to LO internally (EX GRD key toggled so that the EX GRD indicator is off.) For a UUT with a grounded input, the V GUARD must be externally connected to the grounded UUT input (EX GRD key toggled so that the EX GRD indicator is lit). The maximum allowable potential between the V GUARD connector and chassis ground is 20V peak. Refer to "When to use External Voltage Guard" and "Cable Connections" in Section 4 for details.

㉚ **SENSE Binding Posts**

Used in the resistance and voltage functions for sensing at the UUT after you have selected external sense with the EX SNS key or by remote command. The LED indicator above the EX SNS key lights when external sensing is selected.

External Sensing should be used in the dc voltage function when the UUT draws enough current to produce a significant voltage drop in the cables, and in the resistance function when the UUT has a four-wire ohms input and the 5700A is set to 100 kΩ or less. External sensing can also be used in the two-wire ohms function to allow the two-wire compensation circuitry to the UUT terminals. Refer to Refer to "When to use External Sensing," "Four-Wire VS Two-Wire Resistance Connections," and "Cable Connections" in Section 4 for external sensing instructions and illustrations of SENSE connections.

㉛ **OUTPUT Binding Posts**

Provide connection points for ac and dc current and voltage output, as well as resistance. The function of each OUTPUT binding post is defined below:

LO	The common binding post for all output functions including 5725A amplified voltage output, but not Option 5700A-03 Wideband AC or other auxiliary amplifier output.
HI	The active binding post for all output functions including 5725A amplified voltage output, but not Option 5700A-03 Wideband AC or other auxiliary amplifier output.
AUX CURRENT OUTPUT	An optional active binding post for current. It is convenient to use the AUX CURRENT OUTPUT binding post when calibrating a UUT with a separate current input terminal. Refer to "Connecting the 5700A to the UUT" in Section 4 for instructions for using this binding post.

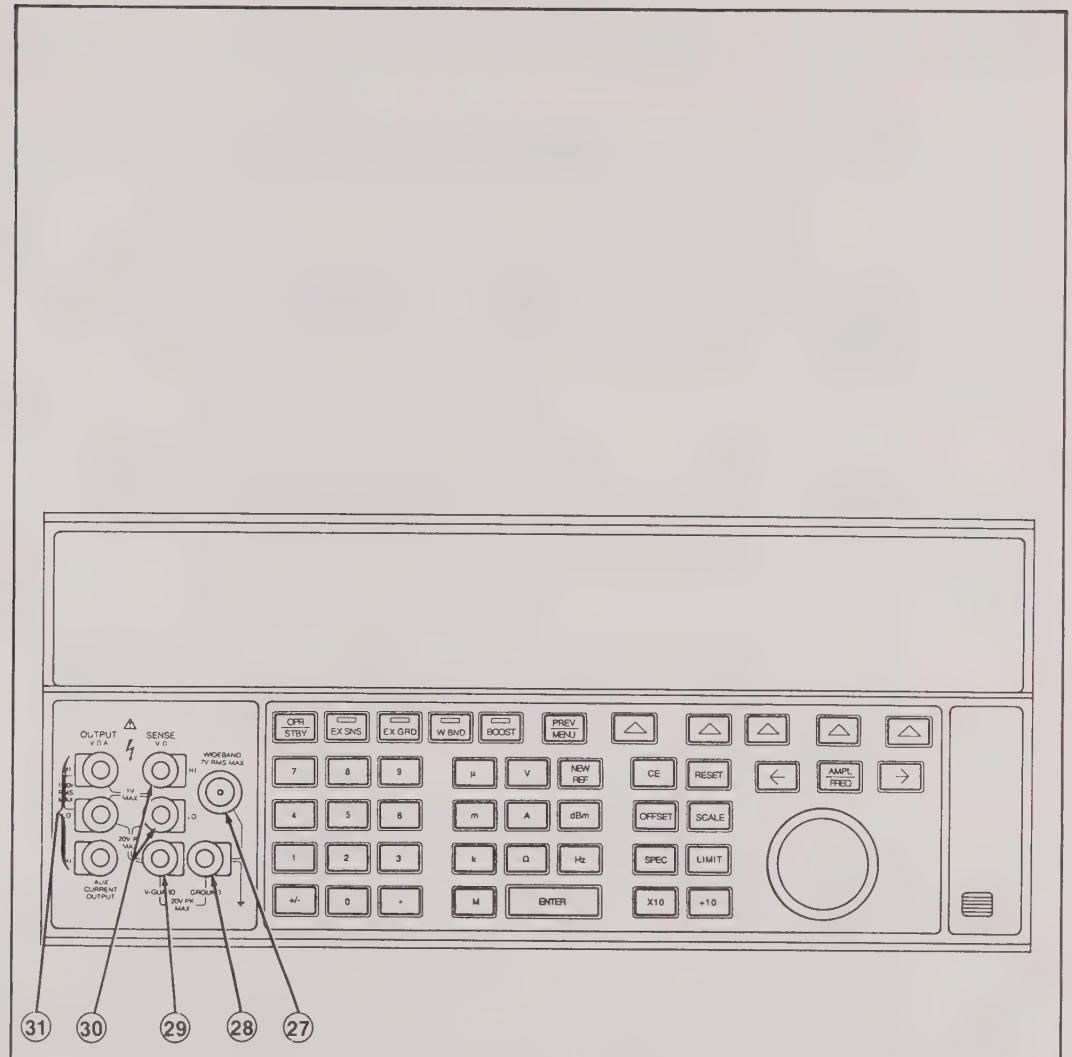


Figure 3-1. Front Panel Features (cont)

Table 3-2. Rear Panel Features

① **Fan Filter**

The filter covers the air intake to keep dust and debris out of chassis air baffles. Fans inside the 5700A provide a constant cooling air flow throughout the chassis. Circuitry inside the 5700A monitors correct operation of the internal fans.

② **5725A AMPLIFIER Connector**

Provides the analog and digital interface for the Fluke 5725A Amplifier. After connecting the 5725A to the 5725A AMPLIFIER connector, you control the 5725A from the 5700A front panel or by remote commands. Refer to "Using an Auxiliary Amplifier" in Section 4 for details.

③ **5205A AMPLIFIER Connector**

Provides the analog and control interface for either the Fluke 5205A or 5215A Precision Power Amplifier. After connecting a 5205A or 5215A to the 5205A AMPLIFIER connector with the Accessory Y5701 interface cable, you control the amplifier from the 5700A front panel or by remote commands. Refer to "Using an Auxiliary Amplifier" in Section 4 for details.

④ **5220A AMPLIFIER Connector**

Provides the analog and control interface for the Fluke 5220A Transconductance Amplifier. After connecting a 5220A to the 5220A AMPLIFIER connector with the Accessory Y5702 interface cable, you control the 5220A from the 5700A front panel or by remote commands. Refer to "Using an Auxiliary Amplifier" in Section 4 for details.

⑤ **VARIABLE PHASE OUT BNC Connector**

Provides access to a variable-phase nominal 2.5V rms sine-wave signal, intended for a 3 kΩ load. The phase of this signal can be adjusted using the arrow keys and rotary knob (or by remote commands) to lead or lag the main 5700A output signal by up to 180 degrees. The connector shell is not connected directly to chassis ground. It is connected internally to the OUTPUT LO binding post. The maximum allowable potential between the connector shell and chassis ground is 20V peak. Refer to "Variable Phase Output" in Section 4 for details.

⑥ **PHASE LOCK IN BNC Connector**

Provides the input for an external signal onto which the 5700A can be phase locked. (1 to 10V rms, 10 kΩ input impedance.) The connector shell is not connected directly to chassis ground. It is connected internally to the OUTPUT LO binding post. The maximum allowable potential between the connector shell and chassis ground is 20V peak. Refer to "Phase Locking to an External Signal," in Section 4 for details.

⑦ **Rear Panel Binding Posts**

The rear-panel OUTPUT, SENSE, and V GUARD and I GUARD binding posts are alternative connections to the UUT. An internal cable enables either the front or rear binding posts. The procedure to disable the front panel binding posts and enable the rear panel binding posts involves opening the cover of the 5700A and is described in Section 4 of the 5700A Service Manual.

The I GUARD binding post provides an external connection point for the internal current guard. The current guard is used when the 5700A is supplying low-level ac current through a long cable to remove errors introduced by leakage through the cable capacitance. The I GUARD binding post is available on the rear panel where it is convenient for system applications. Refer to "When to use the Current Guard" in Section 4 for details.

AUX CURRENT OUTPUT is not available on the rear panel binding posts.

Table 3-2. Rear Panel Features (cont)

⑧	**IEEE-488 Connector** A standard interface connector for operating the 5700A in remote control as a Talker or Listener on the IEEE-488 Bus. Refer to Section 5 for bus connection and remote programming instructions.
⑨	**CALIBRATION Switch** A slide switch that write enables and disables the nonvolatile memory that stores calibration constants, dates, and setup parameter settings. Switching to ENABLE write enables the memory, and switching to NORMAL protects data in memory from being overwritten. The switch must be in the ENABLE position to set the clock. The switch is recessed to allow the metrologist to cover it with a calibration sticker to guarantee calibrator integrity.
⑩	**RS 232C Connector** A male (DTE) serial port connector for transmitting internal calibration constant data to a printer, monitor, or host computer, and for remote control of the 5700A. Section 6 describes proper cabling, how to set up the serial interface, and how to transmit data from the 5700A. Section 5 describes how to use the serial interface for remote control.

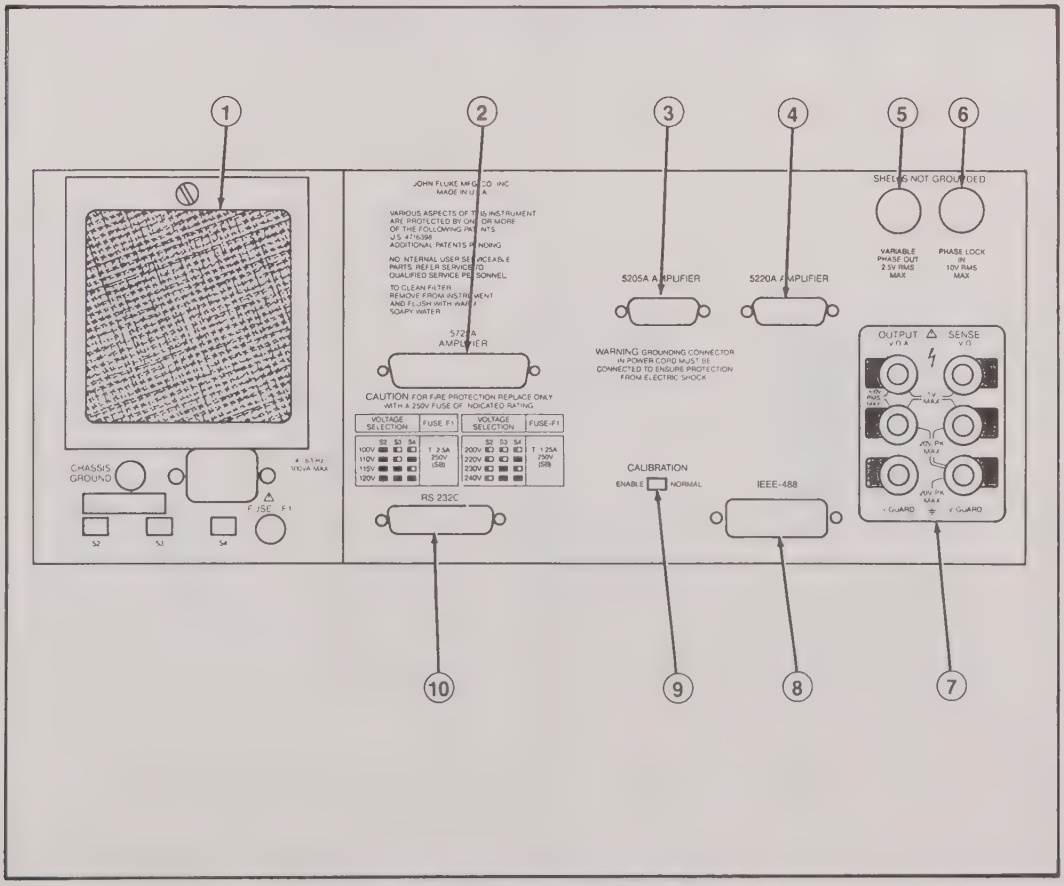


Figure 3-2. Rear Panel Features

Table 3-2. Rear Panel Features (cont)

(11)	**Line Voltage Switch and Fuse Rating Label** Shows the various settings of the line voltage switches, and the correct replacement fuse ratings for fuse F1 for operating voltages of 110 (90-132) and 220 (180-264) V ac. Refer to "Accessing the Fuse" in Section 2 for the fuse replacement procedure.
(12)	**F1 Fuseholder** The line power fuse. Refer to "Accessing the Fuse" in Section 2 for fuse rating information and the fuse replacement procedure.
(13)	**AC PWR INPUT Connector** A grounded male three-prong connector that accepts the line power cord.
(14)	**Line Voltage Selection Switches** Select the operating line voltage. Refer to "Selecting Line Voltage" in Section 2 for how to select operating line voltage.
(15)	**CHASSIS GROUND Binding Post** A binding post that is internally grounded to the chassis. If the 5700A is the location of the ground reference point in a system, this binding post can be used for connecting other instruments to earth ground. (The chassis is normally connected to earth ground through the three-conductor line cord instead of through the earth ground binding post.) Refer to "Connecting to the UUT" in Section 4 for details.

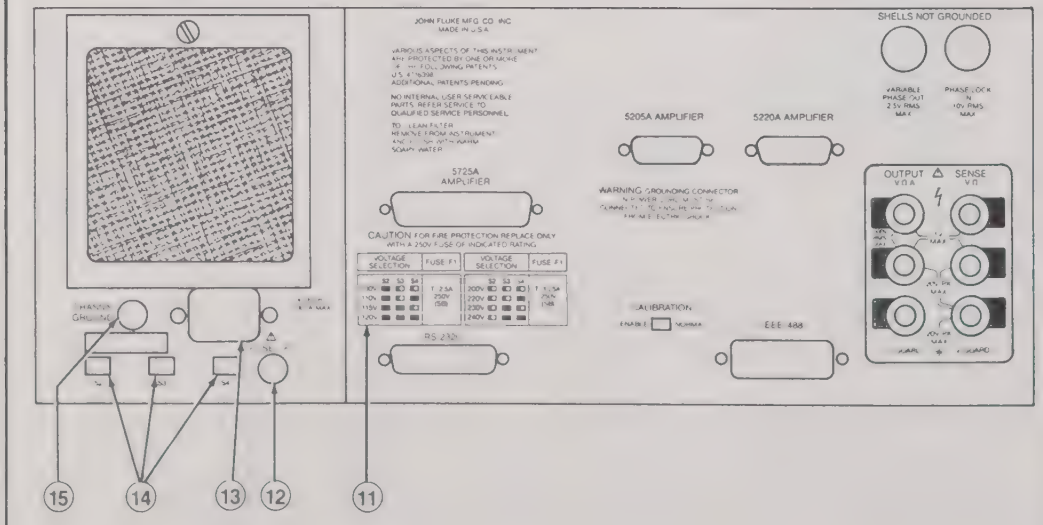
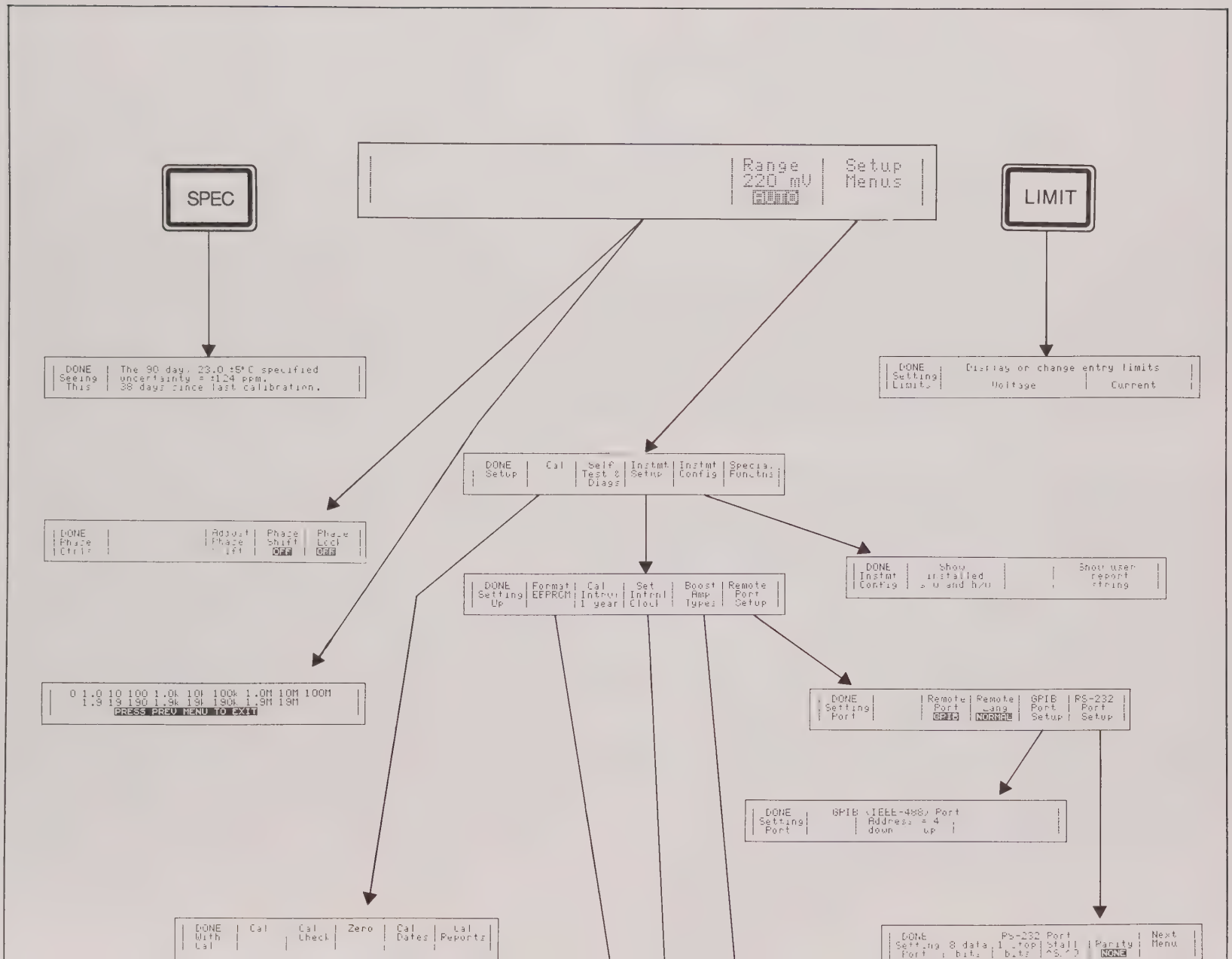


Figure 3-2. Rear Panel Features (cont)


Range
220 mV
Setup
Menus
SPEC
LIMIT
DONE
Seeing
This
The 90 day, 23.0 ±5°C specified
uncertainty = ±124 ppm.
38 days since last calibration.
DONE
Setting
Limits
Display or change entry limits
Voltage
Current
DONE
Setup
Cal
Self
Test &
Diags
Instmt
Setup
Instmt
Config
Specia.
Functns
DONE
Phase
Ctrls
Adjust
Phase
Diff
Phase
Shift
OFF
Phase
Lock
OFF
DONE
Instmt
Config
Show
installed
options
Show user
report
string
DONE
Setting
Up
Format
EEPROM
Cal
Interv
1 year
Set
Intrnl
Cloc
Boost
Amp
Types
Remote
Port
Setup
0 1.0 10 100 1.0k 10k 100k 1.0M 10M 100M
1.9 19 190 1.9k 19k 190k 1.9M 19M
PRESS PREV MENU TO EXIT
DONE
Setting
Port
Remote
Port
GPIB
Remote
Lang
NORMAL
GPIB
Port
Setup
RS-232
Port
Setup
DONE
Setting
Port
GPIB (IEEE-488) Port
Address = 4
down
up
DONE
With
Cal
Cal
Cal
Check
Zero
Cal
Dates
Cal
Reports
DONE
Setting
Port
RS-232 Port
8 data bits
1 stop bit
Stall
Baud
Parity
NONE
Next
Menu

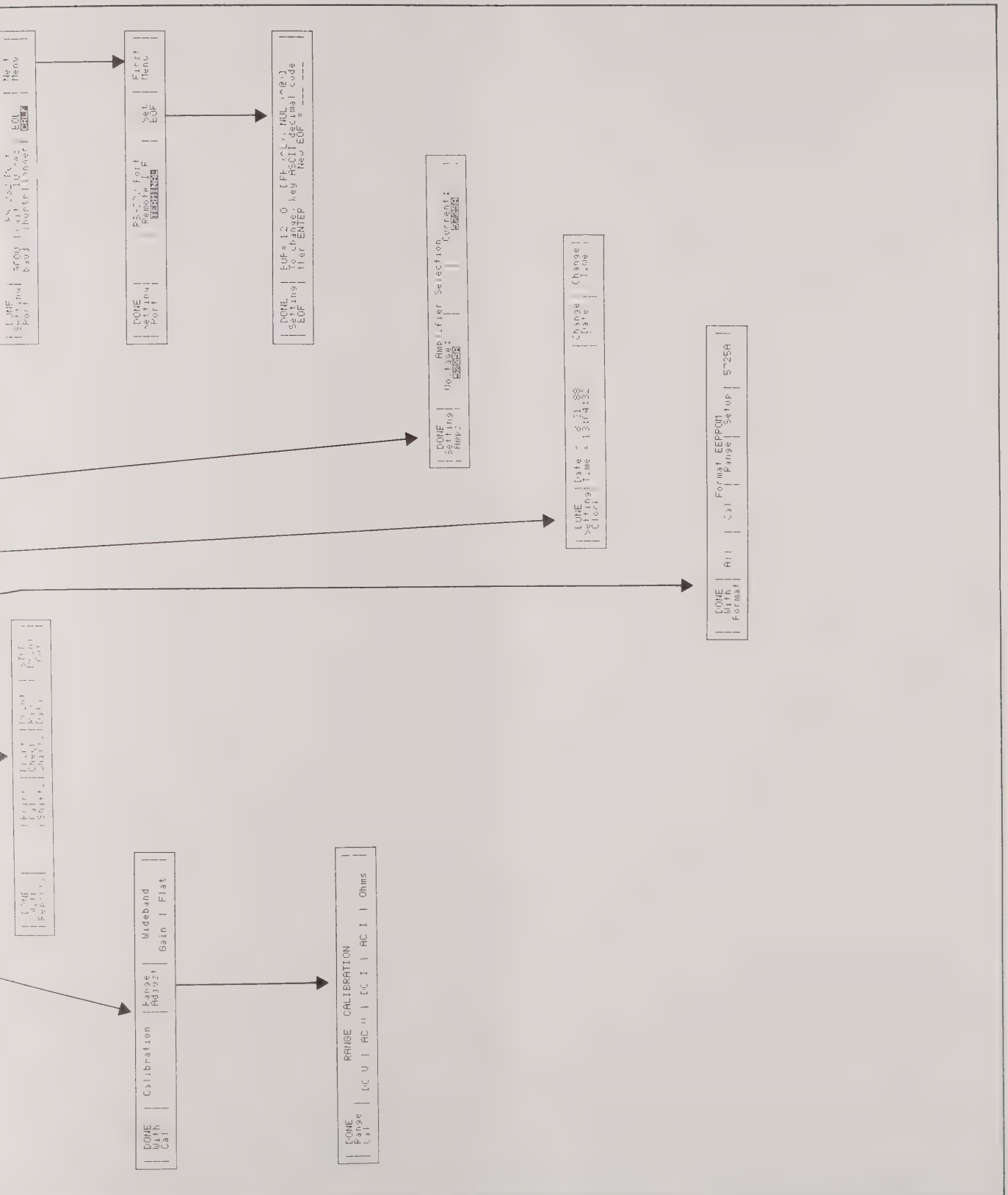


Figure 3-3. Softkey Menu Tree

Section 4
Front Panel Operation

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INTRODUCTION 4-1.

WARNING

THE 5700A CALIBRATOR IS CAPABLE OF SUPPLYING LETHAL VOLTAGES. DO NOT MAKE CONNECTIONS TO THE OUTPUT TERMINALS WHEN ANY VOLTAGE IS PRESENT. PLACING THE INSTRUMENT IN STANDBY MAY NOT BE ENOUGH TO AVOID SHOCK HAZARD, SINCE THE OPR/STBY KEY COULD BE PRESSED ACCIDENTALLY. PRESS THE RESET KEY AND VERIFY THAT STANDBY IS LIT BEFORE MAKING CONNECTIONS TO THE OUTPUT TERMINALS.

This section presents instructions for operating the 5700A from the front panel. The front panel controls, displays, and terminals are identified and described in detail in Section 3.

TURNING ON THE 5700A 4-2.

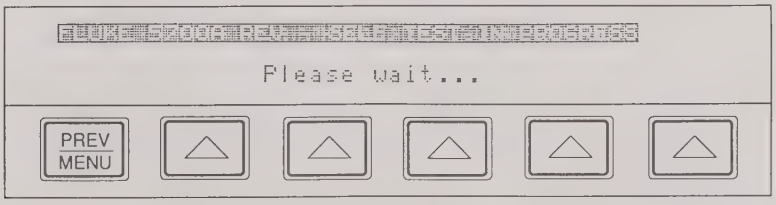
WARNING

TO AVOID ELECTRIC SHOCK, MAKE SURE THE 5700A IS SAFELY GROUNDED AS DESCRIBED IN SECTION 2.

CAUTION

Before turning the 5700A on, make sure that the line voltage selection switches are set properly for your line voltage. Refer to Figure 2-3 or the line voltage switch label and check the line voltage now if you have not already done so.

When you turn on the 5700A, it undergoes thorough self testing and the Control Display appears as shown below. If a self test fails, a prompt on the Control Display identifies the failed test and lets you choose whether to continue self testing or stop and run self diagnostics. For information about self diagnostics, refer to Section 3 of the 5700A Service Manual.



After the 5700A passes all the self tests, it powers up to 0V dc in standby, configured for internal sensing and internal guard, ready to accept an entry from the keypad. The Control Display now looks like this:

WARM UP 4-3.

When you turn on a cold 5700A, warm it up for 30 minutes to allow the environmentally-controlled components inside to stabilize. This ensures that the 5700A meets or exceeds the specifications listed in Section 1.

If you turn off the 5700A after it has warmed up, allow it to warm up again for at least twice the length of time it was turned off (up to a maximum of 30 minutes of warm-up). For example, if the 5700A is turned off for 10 minutes, allow it to warm up again for at least 20 minutes.

DC ZEROS 4-4.

DC zeros is a 15-second automatic internal process that removes the offset error on the 2.2V range. The specifications require that dc zeros be run every 30 days. To run dc zeros, proceed as follows from the power-up state:

1. Press the following sequence of softkeys:

   "Setup Menus" → "Cal" → "Zero"

   (Softkeys are identified by the labels on the display directly above the keys.)

2. When the process is finished, a message appears that tells you to press any key to continue. Press any key.

3. To go to normal operation, press PREV MENU twice.

THE SETUP MENU 4-5.

Through the setup menu you have access to various operations and changeable parameters. Once you set a parameter, it is saved in memory until it is changed, including during power-off periods.

When you press the "Setup" softkey on the Control Display from the power-up state, the display changes to:

This is the setup menu. The list below describes sub-menus available through each softkey and tells you where you can find further information in the manuals.

- Cal: Opens the calibration menu. Softkeys in this menu activate calibration to external standards, calibration check, and dc zeros calibration. Another softkey displays calibration date information and another opens a calibration report menu. This section describes dc zeros calibration. Section 7 shows this menu and describes all other calibration procedures.

- Self Test & Diags: Opens the self testing and diagnostics menu. This menu contains a softkey to run self tests similar to the power-up self tests and softkeys that access separate menus to diagnose and troubleshoot the 5700A and an attached 5725A Amplifier. Section 5 of the 5700A Service Manual provides instructions for using these softkeys.

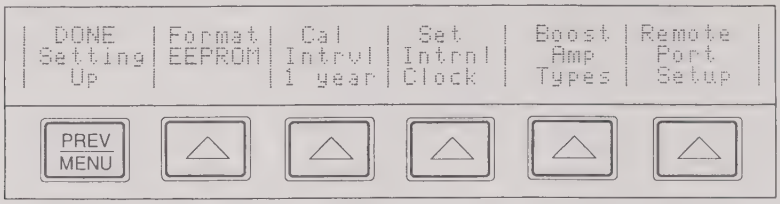
- Instmt Setup: Opens the instrument setup menu. This menu contains softkeys to open sub menus that let you change the calibration interval, set up the remote port, set the clock/calendar, and identify the amplifier model for current and voltage amplification. Another menu lets you format the EEPROM (Electrically-Eraseable Programmable Read Only Memory), which is nonvolatile memory. This is only necessary when you want to replace some or all of the information in memory with default values. The next part of this section describes the instrument setup menu and its sub-menus.

- Instmt Config: Opens a menu that contains two softkeys: one that displays a list of installed hardware modules and software revision letters, and another that displays the contents of the user report string. This section describes how to use these softkeys.

- Special Functns: Opens the special functions menu. This menu exists for future development of special applications.

Instrument Setup 4-6.

The softkeys in the instrument setup menu (accessed by pressing "Instmt Setup" softkey in the setup menu) are shown below.



The list below describes sub-menus accessed by each softkey and tells you where you can find further information in the manuals.

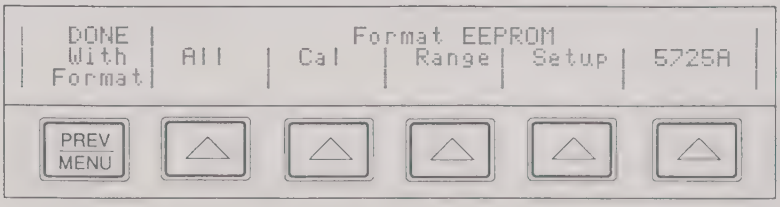
- Format EEPROM: Opens a menu that lets you restore all or part of the data in the EEPROM to factory defaults. The use of this menu is described next.
- Cal Intrvl: Sets the calibration cycle length to 24 hours, 90 days, 180 days, or 1 year. This defines the stored specification table that the SPEC key refers to and calibration reports use. Section 7 describes 5700A calibration.
- Set Intrnl Clock: Accesses softkeys that allow you to check and set the date and time for the clock/calendar. This section describes how to set the time and date.
- Boost Amp Types: Selects the auxiliary amplifier model number for current and voltage boost. This section describes how to select the boost amp type.
- Remote Port Setup: Opens setup menus for the IEEE-488 instrument control port and the RS-232-C serial interface port. Section 5 describes how to set up the IEEE-488 interface. Section 6 describes how to set up the serial interface.

Format EEPROM Menu 4-7.

CAUTION

Use with extreme care. The format EEPROM menu presents softkeys that permanently erase calibration constants. Pressing "ALL" or "CAL" invalidates the state of calibration of the 5700A.

Pressing "Format EEPROM" in the instrument setup menu opens the following menu:



The EEPROM is the nonvolatile memory device. It contains calibration constants and dates, setup parameters, and the user report string. Its contents are saved when the power is turned off. Softkeys in this menu let you replace all or part of the contents with factory defaults. In the case of calibration constants, factory defaults are the same for all 5700A's. They are not the calibration constants obtained when the 5700A was originally calibrated by the factory before shipment. All the softkeys in this menu require the rear panel CALIBRATION switch to be in the ENABLE position. The function of each softkey is described below:

- ALL: Replaces the entire contents of the EEPROM with factory defaults. This would be used by service personnel after replacing the EEPROM, for example. It is not required in normal use.

- CAL: Replaces all calibration constants with factory defaults but leaves all the setup parameters unchanged. This is also not required in normal use.

- RANGE: Removes only the range adjustments made during optional range calibration. See Section 7 for more information about range calibration.

- SETUP: Replaces the setup parameters with factory defaults, but leaves the state of calibration unchanged.

- 5725A: Replaces all calibration constants stored in the attached 5725A with factory defaults, but leaves the 5700A EEPROM contents unchanged.

Setting the Internal Clock/Calendar 4-8.

An internal clock/calendar provides the date (corrected for leap-years) and time to the 5700A CPU (Central Processing Unit). The clock setting should be checked and set if necessary.

NOTE

A long-life lithium battery keeps the clock/calendar running during power-off periods. If the battery in your 5700A should ever need replacement, refer to the Service Manual. The battery is a button-type, soldered to the CPU Assembly (A20). Any procedure that involves removing the cover is for service personnel only.

To set or change the time and date of the internal clock/calendar, proceed as follows:

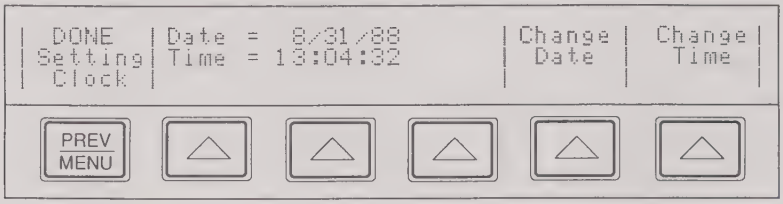
1. If you want to set the date or both date and time, set the rear panel CALIBRATION switch to ENABLE. (See Figure 3-2.) The setting of the CALIBRATION switch does not matter for setting time only.

2. Press the following sequence of softkeys:

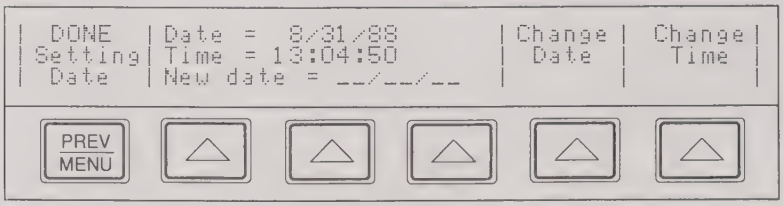
   "Setup Menus" → "Instmt Setup" → "Set Intrnl Clock"

   (If Setup Menus is not showing, press RESET first.)

   The display changes to:



3. To change the date, press the "Change Date" softkey. (To leave the date setting as is and change the time instead, skip to step 5.) The display changes to:



4. Enter the date as six digits in the format "mmddyy" using the numeric keypad (for example, 090588 for September 5, 1988). Press ENTER.

5. Press the "Change Time" softkey. The display changes to:

6. Enter the 24-hour time as six digits in the format "hhmmss" using the numeric keypad (for example, 080500 for 8:05 am, or 130400 for 2:04 pm). Press [ENTER]. (The clock begins running at the new setting when you press [ENTER].)

7. Set the rear panel CALIBRATION switch to NORMAL. (If you changed it.)

8. To go to normal operation, press [PREV MENU] three times.

Selecting Amplifiers 4-9.

If you plan to use an auxiliary amplifier other than the 5725A, you may identify one amplifier for current boost and one amplifier for voltage boost. Model 5725A is the factory setup for both voltage and current boost. To select other amplifiers, proceed as follows:

1. Press the following sequence of softkeys:

   "Setup Menus" → "Instmt Setup" → "Boost Amp Types"

   (If Setup Menus is not showing, press [RESET] first.)

   The display changes to:

2. Press a softkey under "Voltage:" to scroll the highlighted label until it displays 5725A, 5205A, or 5215A as desired.

3. Press a softkey under "Current:" to scroll the highlighted label until it displays 5725A or 5220A as desired.

4. To go to normal operation, press [PREV MENU] three times.

Checking the Instrument Configuration 4-10.

The softkey labeled "Instmt Config" in the setup menu gives you access to the following information:

- Installed internal operating software revision.
- Whether the Wideband AC Module (Option 5700A-03) is installed.
- Which auxiliary amplifiers, if any, are attached.
- The contents of the user report string (a general-purpose data storage location that is changeable only in remote control using the RPT_STR command). You can use this register to store a property identification name or number, verification test record number, or other message. The message appears on calibration report printouts as described in Section 6. The rear panel CALIBRATION switch must be in the ENABLE position to change the user report string. Refer to Section 5 for how to use the RPTSTRING remote command.

To view this information, proceed as follows:

1. Press the "Setup Menus" softkey, then press the "Instmt Config" softkey. The display changes to:

   (If Setup Menus is not showing, press RESET first.)

2. Press either softkey under "Show installed s/w and h/w." The display now shows the installed internal operating software revisions. To view the installed and attached hardware assemblies, press the "Go to h/w config" softkey.

3. After you have read the display, press the "MORE" softkey. If there are any more assemblies to display, they are displayed. After there are no more assemblies to display, the "h/w config" softkey returns control to the menu shown in step 1.

4. To return to normal operation, press PREV MENU twice.

To display the contents of the user report string, proceed as follows:

1. Press the "Setup Menus" softkey, then press the "Instmt Config" softkey.

   (If Setup Menus is not showing, press [RESET] first.)

2. Press a softkey under the "Show user report string" label. This prints the user report string on the Control Display. To clear the display, press [PREV MENU].

3. To go to normal operation, press [PREV MENU] twice.

RESETTING THE 5700A 4-11.

At any time during front panel operation, you can return the 5700A to the power-up state by pressing [RESET]. Pressing [RESET] does the following:

- Returns the 5700A to the power-up state: 0 mV dc, standby, internal guard, and internal sense.
- Clears the stored values for limits, offset, scale, and error mode reference.

OPERATE AND STANDBY MODES 4-12.

When the OPERATE annunciator is lit, the output value and function shown on the Output Display is active at the selected terminals. When the STANDBY annunciator on the Output Display is lit, all 5700A binding posts except GROUND are open-circuited. To toggle between operate and standby modes, press [OPR STBY].

When operating and any of the following events occur, the 5700A automatically trips into to standby:

- The [RESET] key is pressed.
- A voltage $\geq$ 22V is selected when the previous output voltage was less than 22V.
- Output function is changed between voltage, current, or resistance.
- The output location is changed, for example by selecting an amplifier.

CONNECTING THE 5700A TO A UUT 4-13.

WARNING

THE 5700A CALIBRATOR IS CAPABLE OF SUPPLYING LETHAL VOLTAGES. DO NOT MAKE CONNECTIONS TO THE OUTPUT TERMINALS WHEN ANY VOLTAGE IS PRESENT. PLACING THE INSTRUMENT IN STANDBY MAY NOT BE ENOUGH TO AVOID SHOCK HAZARD, SINCE THE OPR/STBY KEY COULD BE PRESSED ACCIDENTALLY. PRESS RESET AND VERIFY THAT STANDBY IS LIT BEFORE MAKING CONNECTIONS TO THE OUTPUT TERMINALS.

The binding posts labeled OUTPUT (HI, LO, and AUX I) deliver voltage, fixed resistance, and current to the UUT (Unit Under Test). The Type "N" connector on the front panel labeled WIDEBAND delivers the output signal from the Option 5700A-03 Wideband AC Module.

Depending on the output function, output amplitude, and input configuration of the UUT (Unit Under Test) or meter, connection to the SENSE binding posts, the GUARD binding post, and the GROUND binding post may also be required or recommended. The text in this section explains how and when to use these binding posts.

Recommended Cable and Connector Types 4-14.

Cables to the 5700A can be connected to the binding posts using banana jacks, terminal lugs, or stripped insulated wire. To avoid errors induced by thermal voltages (thermal emfs), use connectors and conductors made of copper or materials that generate small thermal emfs when joined to copper. Avoid using nickel-plated connectors. Optimum results can be obtained by using Fluke Model 5440A-7002 Low Thermal EMF Test Leads, which are constructed of well-insulated copper wire and tellurium copper connectors.

Cable requirements are different depending on the output function, amplitude, and frequency. Table 4-1 gives specific cable recommendations for all applications.

CAUTION

Use only cables with correct voltage ratings.

Table 4-1. Cable Recommendations

OUTPUT FUNCTION	CABLE RECOMMENDATIONS
DC Voltage AC Voltage ≤10 kHz AC Current ≤2A, ≤10 kHz DC Current ≤2A Resistance	Low Thermal EMF Test Leads (5440A-7002) (Or use twisted shielded pair if external sensing is necessary.)
AC Voltage >10 kHz	SENSE/GUARD: Triaxial cable or Twinax (e.g., Alpha 2829/2), OUTPUT: Coaxial Or: SENSE: Coaxial, OUTPUT: Coaxial GUARD Lead: Separate wire
AC Current with Guard	Triaxial cable
Wideband AC	3 ft (1m) 50Ω coaxial cable with Type "N" male connector supplied with the option. A 50Ω feed-through terminator is also supplied for connecting to meters with impedance higher than 50Ω.
Voltage-Boosted Output, 5205A or 5215A	Use the cable supplied with the amplifier
Voltage-Boosted Output, 5725A	Low Thermal EMF Test Leads (5440A-7002). (Output is at the 5700A front panel.)
Current-Boosted Output, 5725A, 5220A	16-gauge or heavier twisted-pair insulated wire, as short as possible to minimize resistance and inductance. (Output is at the amplifier terminals.)

When to Use External Sensing

4-15.

External sensing is normally required only when you are calibrating a device that draws enough current to produce a significant voltage drop in the cables. An example of such a case is using the 5700A as an external dc voltage reference for an ac/dc transfer standard. In this example, the 5700A is sourcing 1V dc into a Fluke 540B AC/DC Transfer Standard. The 180Ω input impedance results in a current flow of approximately 5 mA. 5700A 90-day uncertainty at 1V is specified to be ±(6 ppm + 1.2μV) or ±7.2μV. Cumulative lead and contact resistances of as little as 2 mΩ would cause a voltage drop greater than the total uncertainty of the 5700A. External sensing eliminates this error. (Figure 4-1B shows the connection used in this example.)

The normal power-up state of the 5700A is external sensing off, with an internal connection between the SENSE and OUTPUT automatically made. This is the state achieved by pressing EX SNS so that the indicator is off.

When to Use External Voltage Guard

4-16.

The voltage guard is an electrical shield around the sensitive analog circuitry, insulated from the rest of the calibrator. It includes a shield between the primary and secondary of the ac line power transformer. An optical cable transmits control information from the 5700A microprocessor to analog circuits. The voltage guard provides a low-impedance path for common-mode noise and ground loop currents.

The voltage guard is usually internally connected to the calibrator OUTPUT LO terminal. This is the normal power-up state of the 5700A, and the connection is automatically made when the external guard is not selected EX GRD pressed so that the indicator is off).

External connection to the V GUARD terminal is required when you are calibrating a UUT with a grounded low or common input terminal. In such a case, the 5700A's voltage guard must be grounded at the UUT. (To avoid ground loops you must have only one ground connection in the system; therefore you make all ground connections at the UUT. To maintain one ground point, make sure there is no grounding strap connected at the 5700A.)

When to Use the Current Guard

4-17.

The rear panel CURRENT GUARD is required only when the 5700A is supplying low-level ac current through a long cable, such as in a system. For that reason, a current guard terminal is supplied on the rear panel where it is convenient for system applications.

The current guard is active only when the 5700A is in the ac current function. The guard is voltage driven and is in phase with the 5700A output current to the level of compliance voltage at the OUTPUT HI terminal. Compliance voltage is the sum of the UUT burden voltage and the additional burdens of contact resistances and cable losses. When connected to the inner shield of a triaxial cable, the current guard blocks a potentially significant leakage path by surrounding the output current with an in-phase voltage at the same potential. Current leakage still occurs, but only between the guard voltage on the inner cable shield and the grounded outer cable shield.

An example where current guarding is desirable is sourcing 100 uA at 1 kHz through a 3-meter coaxial cable into a UUT with a burden voltage of 1V. At 100 pF per meter of length, the cable places an additional 300 pF load across the 5700A output. The amount of current leakage through the cable capacitance is:

$$i = V (2 \pi fC)$$

Where,

$V = 1V$

$f = 1\ kHz$
$= 1 \times 10^{3}\ Hz$

$C = 300\ pF$
$= 300 \times 10^{-12}\ Farad$

So the total leakage is:

$$i = (1)(2)(\pi)(10^{3})(300)(10^{-12})$$
$$= 1.9\ \mu A$$

This will add in quadrature to the current through a resistive load causing an error of:

$$\sqrt{100^{2} + 1.9^{2}} - 100 = 0.018\ \mu A$$

At 100 μA, 5700A 90-day uncertainty is specified to be $\pm$140 ppm + 20 nA, or $\pm$0.034 μA. The current leakage here is over half the 5700A uncertainty. The error caused by this leakage can be minimized by using the current guard.

Four-Wire VS Two-Wire Resistance Connections 4-18.

Figure 4-4 shows four different ways to connect to a UUT for resistance calibration. Figure 4-4A shows a UUT with four-wire sensing. For such meters, you should always take advantage of the four-wire sensing capability and use external sensing to achieve the highest accuracy. (Four-wire sensing is available for all resistance values except 100 MΩ.)

For calibrating a meter with only a two-wire resistance mode such as a typical handheld DMM, refer to Figures 4-4B through 4-4D. For resistances of 19 kΩ or lower in two-wire mode, compensation circuitry inside the 5700A is available to remove errors introduced by resistance in the path between the front panel terminals and the precision resistor. Depending on how you connect the meter, you can use two-wire compensation referenced at the UUT terminals (Figure 4-4C) or at the ends of the UUT's test leads (Figure 4-4D). See "Resistance Output" for information on turning on and off two-wire compensation circuitry.

Figure 4-4B shows a meter connected in a two-wire connection with the two-wire compensation circuitry turned off. For low resistances where uncompensated lead resistances are significant, use the two-wire compensation circuit and the connection in Figure 4-4C or 4-4D. Use the connection in Figure 4-4C if you want to calibrate the meter referenced at its terminals. Use the connection in Figure 4-4D if you want to calibrate the meter referenced at the end of its test leads.

Cable Connection Instructions 4-19.

To connect the 5700A to a UUT, proceed as follows:

1. If the 5700A is turned on, press [RESET], or [0] [V] followed by [ENTER]. Either action sets the 5700A to 0 mV in standby.

2. Determine the appropriate figure from Table 4-2, and refer to the preceding text and Table 4-1 to make appropriate connections to the UUT.

Table 4-2. UUT Connection Figures

5700A OUTPUT	FIGURE
DC Voltage (including 5725A boost)	4-1
AC Voltage ≤10 kHz	4-1
AC Voltage >10 kHz	4-2
AC Current ≤2A, ≤10 kHz	4-3
Resistance	4-4
Wideband AC Voltage (Option 5700A-03)	4-5
5725A Amplified Output (Current Only)	4-6
5205A/5215A Amplified Output	Refer to the 5205A or 5215A Instruction Manual
5220A Amplified Output	Refer to the 5220A Instruction Manual

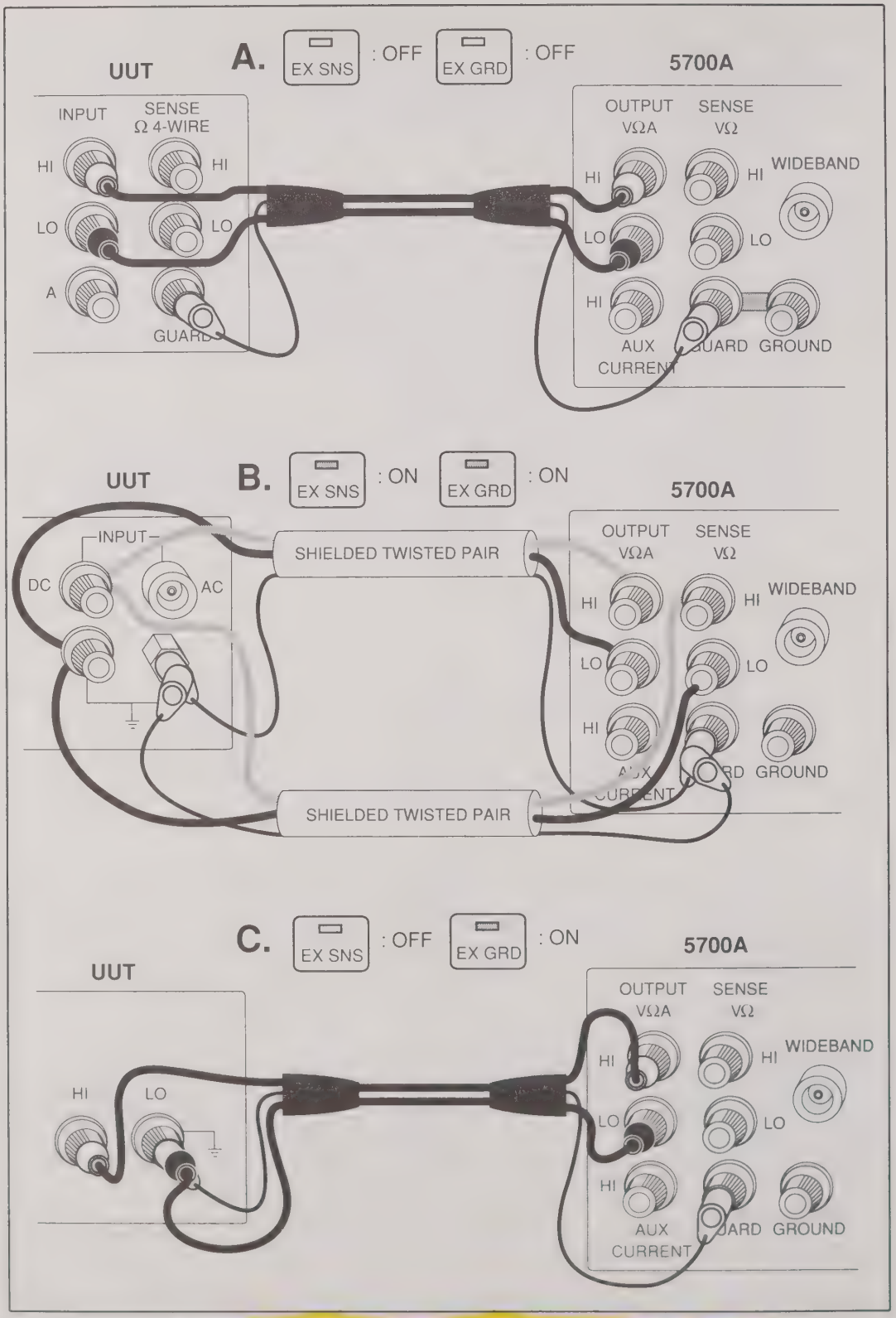
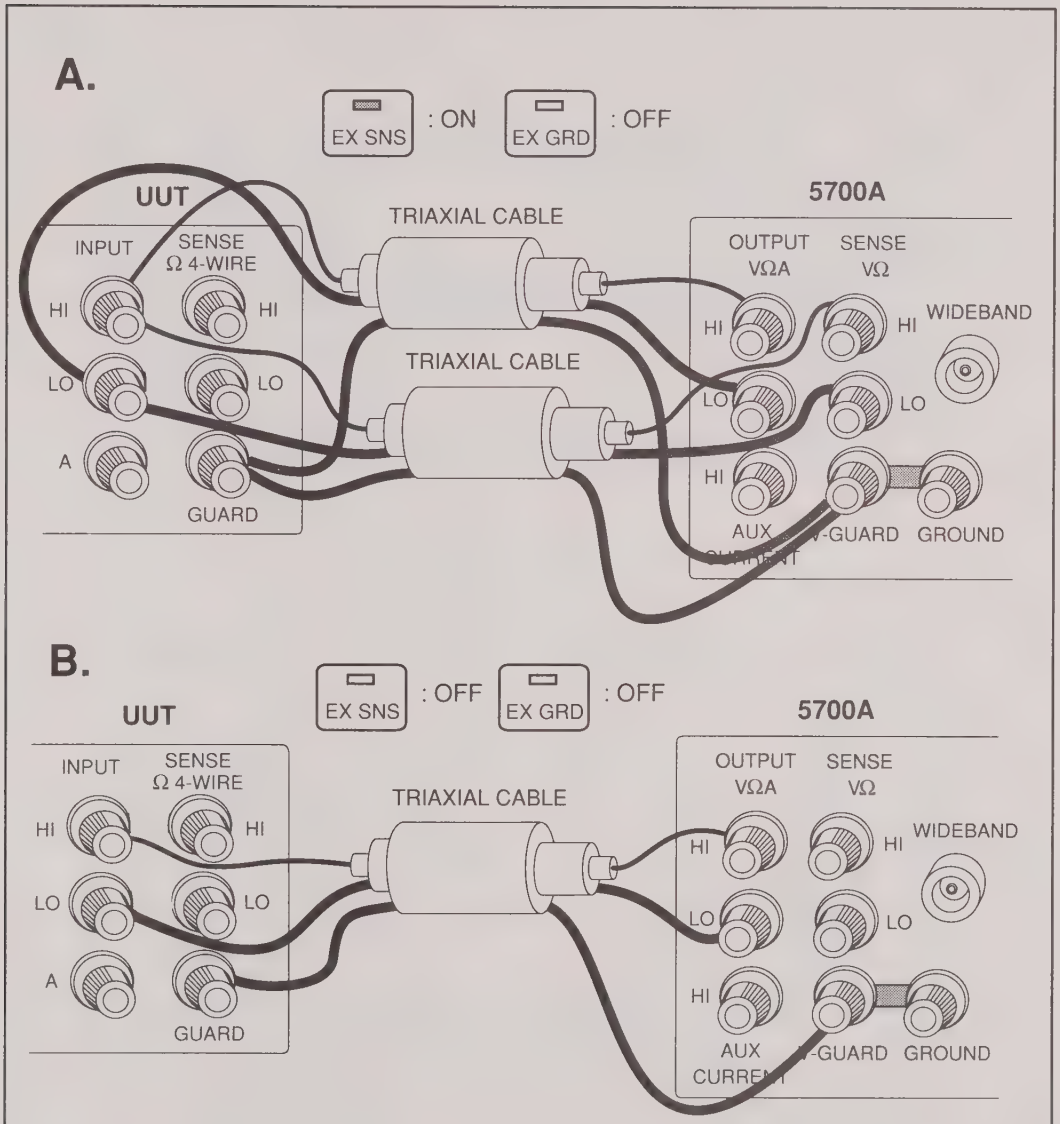


Figure 4-1. UUT Connection: DC Voltage, AC Voltage ≤ 10 kHz

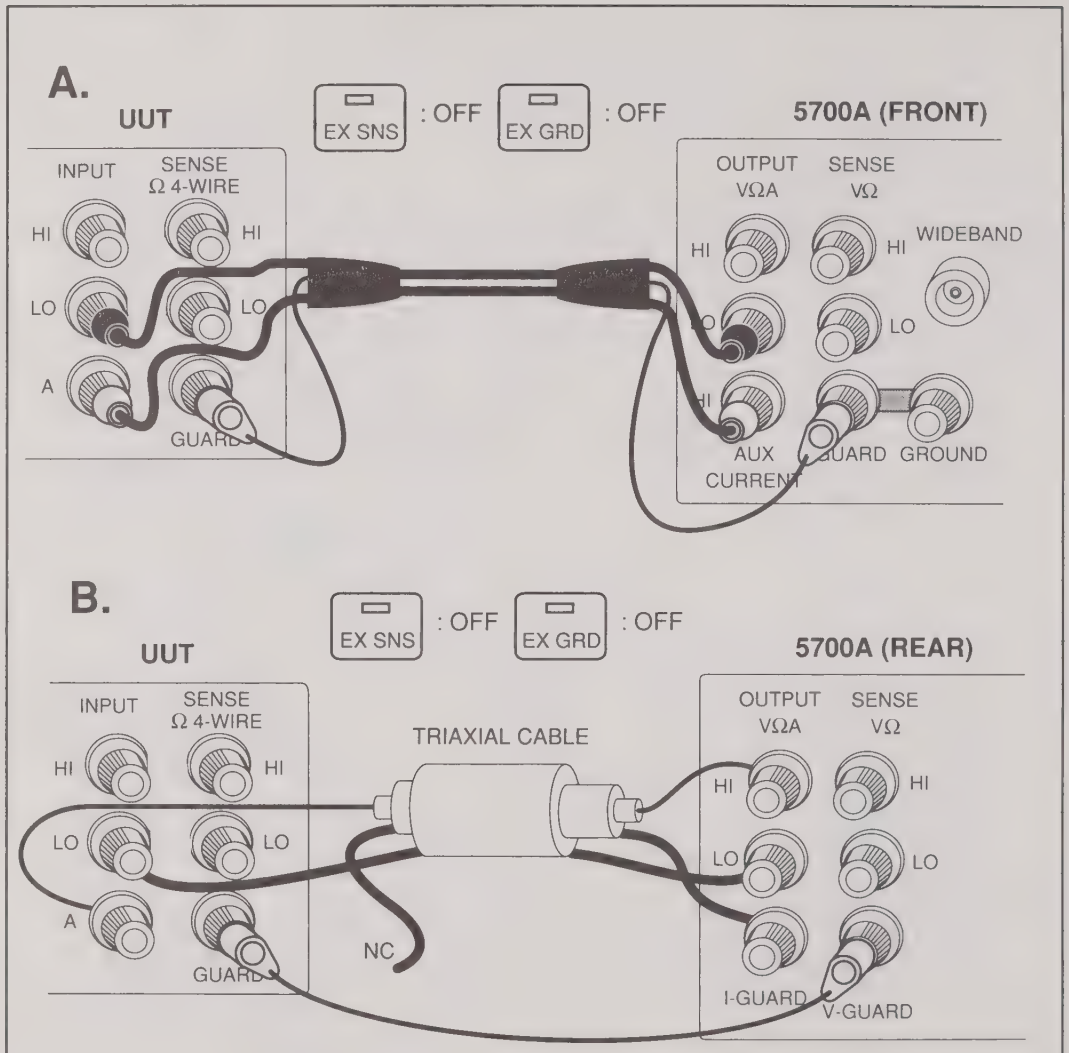


NOTE

Keep the SENSE leads as short as possible.

Be careful not to exceed the capacitive load limit of 1000 pF up to 220V, 600 pF 220 to 1100V. (1000 pF with 5725A Amplifier.)

Figure 4-2. UUT Connections: AC Voltage > 10 kHz



NOTE

The AUX CURRENT OUTPUT binding post is shown in use in figure 4-3A. You can use the OUTPUT HI binding post or the 5725A Boost Amplifier binding posts as the active terminals for current output. The operating instructions in the text describe how you select the active terminal. If you do not select current output location, OUTPUT HI is active.

Figure 4-3. UUT Connections: AC Current ≤ 2A

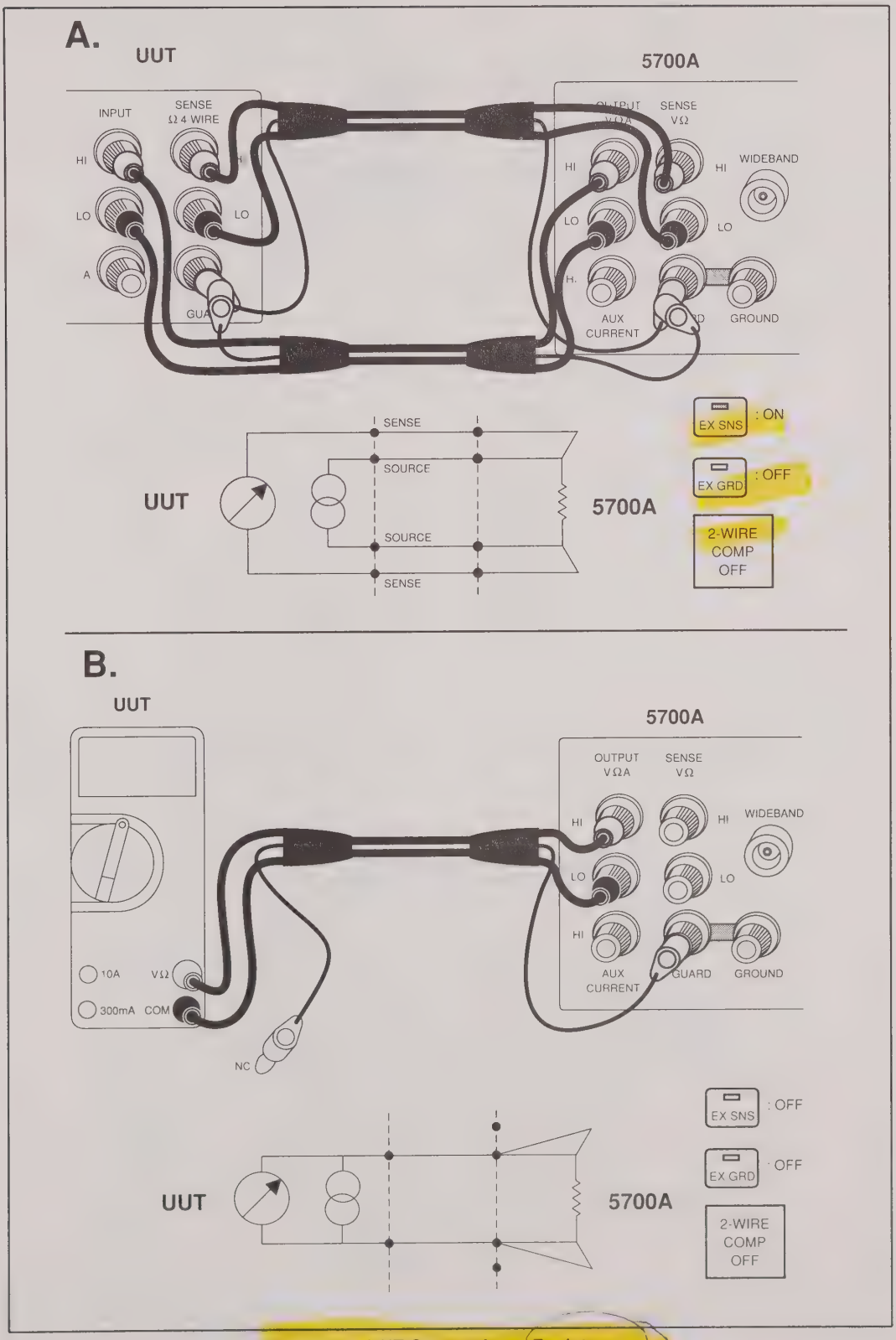


Figure 4-4. UUT Connections: Resistance

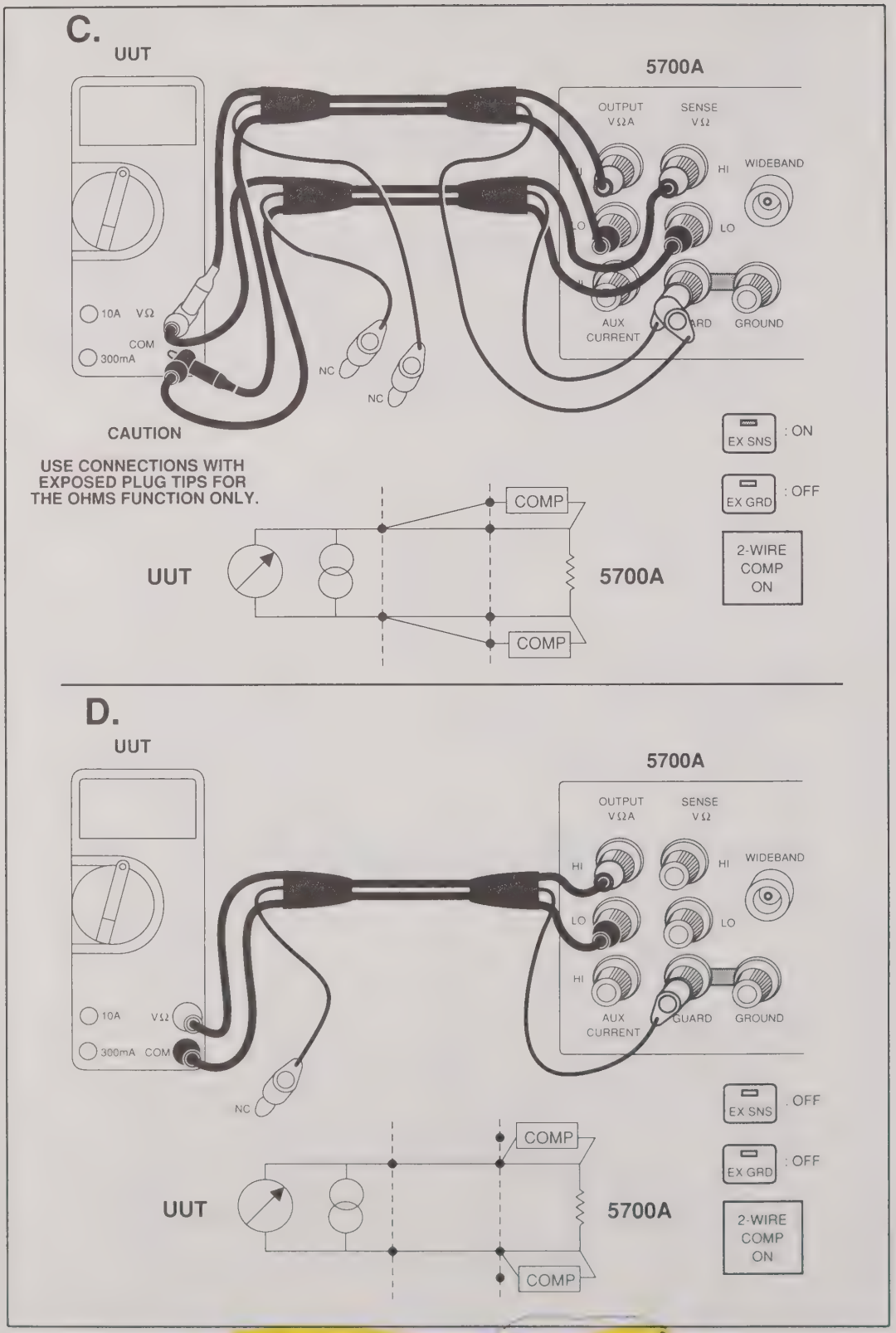


Figure 4-4. UUT Connections: Resistance (Cont)

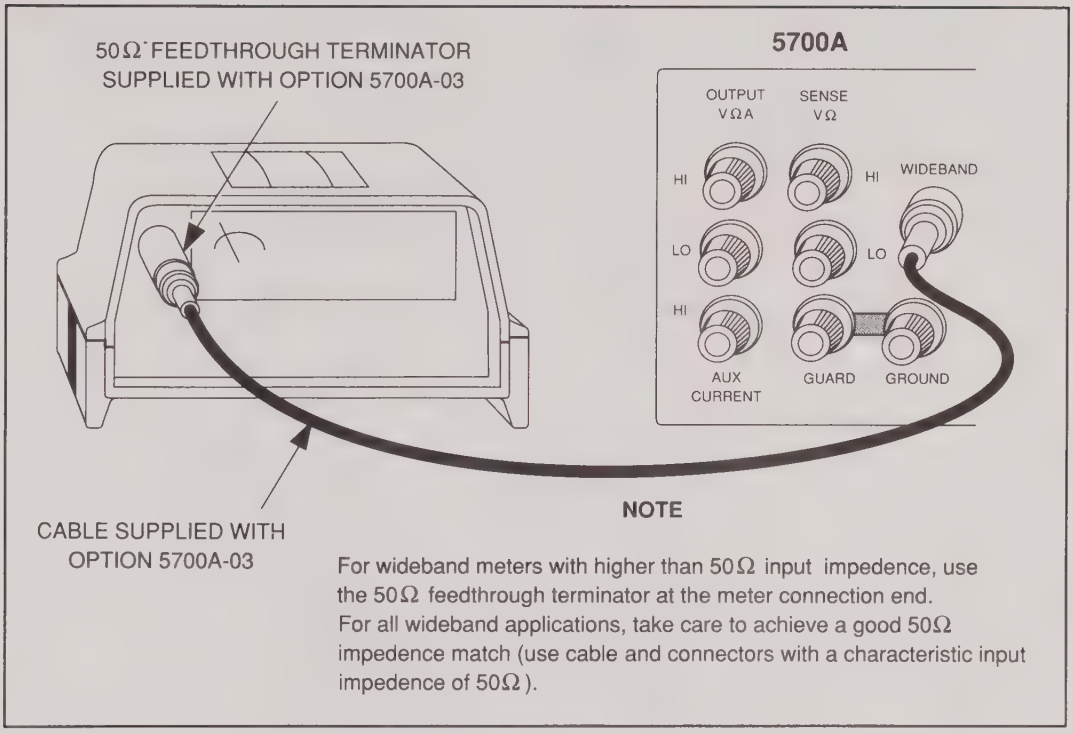


Figure 4-5. Wideband AC Voltage Output (Option 5700A-03)

SETTING THE OUTPUT 4-20.

To set the output, simply press the following sequence of keys to select an output function and amplitude:

[numeric keys] → [multiplier] → [function] → ENTER → PREV MENU

For example, to set the output to 10 mV dc, press:

1 0 m V ENTER OPR STBY

To set an ac output, press the following additional keys:

[numeric keys] → [multiplier] → Hz → ENTER

For example, to change the present 10 mV dc to 10 mV ac at 1.8 kHz, press:

1 • 8 k Hz ENTER

To change the output back to dc, simply press:

0 Hz ENTER, or

+/- ENTER

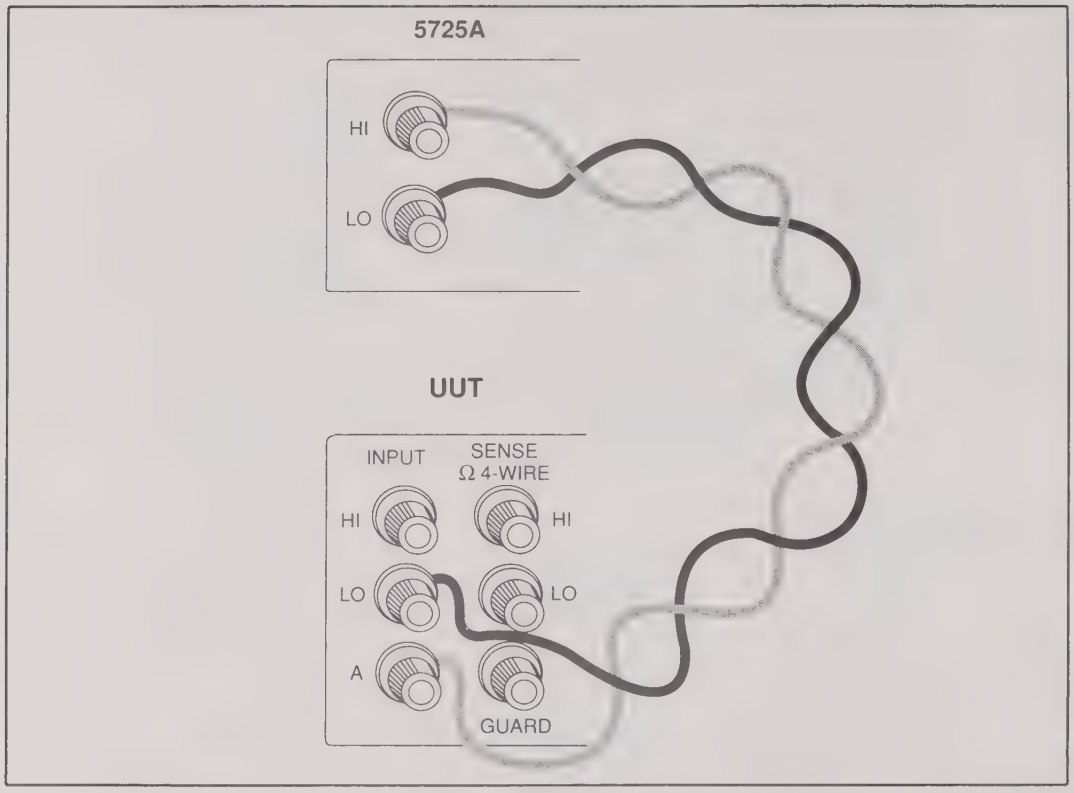


Figure 4-6. UUT Connections: 5725A Amplified Current Output

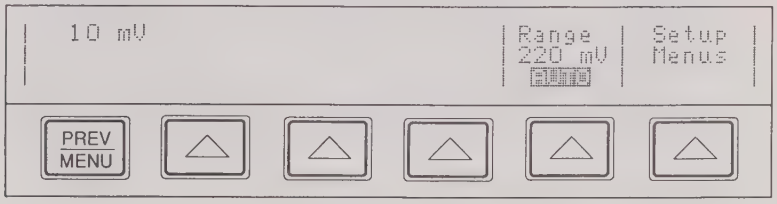
The following step-by-step procedures explain how to set a desired output and how to use the features available for each output function:

- DC voltage
- AC voltage
- DC current
- AC current
- Resistance
- Wideband ac voltage (Option 5700A-03)
- Variable phase
- Boost operation (using an auxiliary amplifier)

DC Voltage Output 4-21.

To set a dc voltage output, proceed as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.
2. If the UUT is not connected, connect it now as described earlier in this section under "Connecting the 5700A to a UUT."
3. Set the UUT to measure dc voltage on the appropriate range.
4. Press up to eight numeric keys to select a voltage.
5. To change the polarity of your entry, press [+/-].
6. Press [μ], [m], or [k] if necessary.
7. Press [V].
8. The Control Display now shows the amplitude of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 10 mV:



9. Press [ENTER] The 5700A clears your entry from the Control Display and copies it into the Output Display. No voltage is available at the output terminals, however, until you press [OPR STBY].
10. Press [OPR STBY] to activate the 5700A output. The UUT will now respond to the applied voltage.

Two softkey labels appear on the Control Display in the dc voltage function: "Range" and "Setup Menus".

- The "Range" softkey selects autorange or lock for the present range. When the range is set to AUTO (the default setting), the 5700A automatically selects the lowest possible range. The minimum output on all ranges except the 1100V range is 0V. The minimum output on the 1100V range is 100V.
- The "Setup Menus" softkey opens the setup menu.

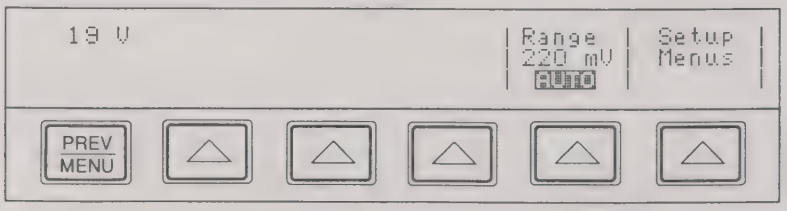
AC Voltage Output 4-22.

To set an ac voltage output, proceed as follows:

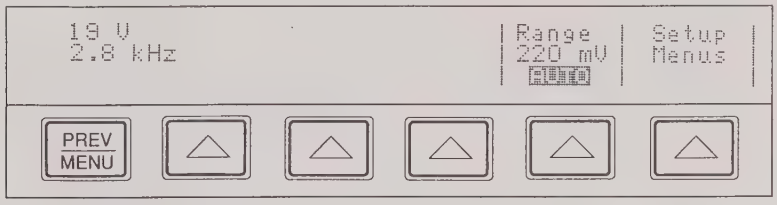
1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.
2. If the UUT is not connected, connect it now as described earlier in this section under "Connecting the 5700A to a UUT."
3. Set the UUT to measure ac voltage on the appropriate range.
4. Press up to seven numeric keys to select a voltage output in volts or dBm.

> In the ac voltage function, dBm means decibels relative to 1 mW, calculated for a 600Ω load. The formula to calculate dBm is 10 log (power in mW). For example, if 3.0V is supplied to a 600Ω load, the dBm level is:
>
> 10 log (15.0 mW) = 11.7609 dBm.
>
> If you switch to Wideband AC output, but keep dBm as the displayed units, the dBm value will change. The value changes because dBm is calculated for a 50Ω load in the Wideband AC output function. Using the same voltage level as in the previous example, if you switch to Wideband AC output, the dBm level changes to:
>
> 10 log (180.0 mW) = 22.5527 dBm.

5. To enter a negative dBm value, press [+/-].
6. Press [μ], [m], or [k] if necessary.
7. Press [V] for volts, or press [dBm] for a dBm level.
8. The Control Display now shows the amplitude of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 19V:



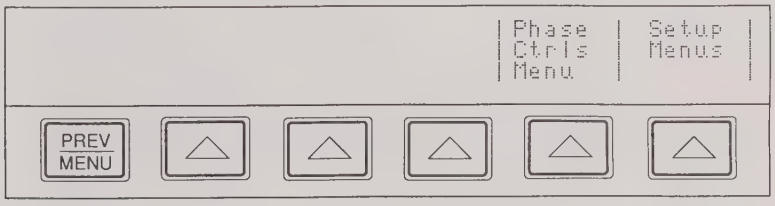
9. Press up to five numeric keys to select a frequency, followed by [k] or [M] if necessary. The Control Display now shows the amplitude and frequency of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 2.8 kHz:



10. Press [ENTER]. The 5700A clears your entry from the Control Display and copies it into the Output Display. No voltage is available at the output terminals, however, until you press [OPR STBY].

11. Press [OPR STBY] to activate the 5700A output. The UUT will now respond to the applied voltage.

Two softkey labels appear on the Control Display in the ac voltage function: "Phase Ctrls Menu" and "Setup Menus":



- The "Phase Ctrls Menu" softkey activates the front panel controls for phase output. (Instructions for setting a phase output are under "Phase Output," later in this section.)

- The "Setup Menus" softkey opens the setup menu.

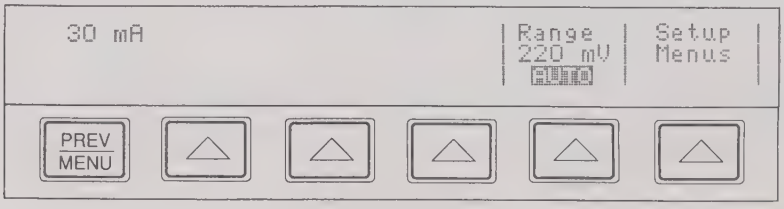
NOTE

The 5700A stays in the ac function after you enter a non-zero frequency. If you want to change back to dc, simply enter a frequency of 0 Hz or a signed voltage.

DC Current Output 4-23.

To set a dc current output, proceed as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.
2. If the UUT is not connected, connect it now as described earlier in this section under "Connecting the 5700A to a UUT."
3. Set the UUT to measure dc current on the appropriate range.
4. Press up to seven numeric keys to select an amperage level.
5. To change the polarity of your entry, press [+/-].
6. Press [μ] or [m] if necessary.
7. Press [A].
8. The Control Display now shows the amplitude of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 30 mA:



9. Press [ENTER]. The 5700A clears your entry from the Control Display and copies it into the Output Display. No current is available at the output terminals, however, until you press [OPR STBY].
10. Press [OPR STBY] to activate the 5700A output. The UUT will now respond to the applied current.

Three softkey labels appear on the Control Display in the dc current function: "Currnt Output", "Range", and "Setup Menus":

- The "Currnt Output" softkey selects one of three locations for current output: the OUTPUT binding post (NORMAL, which is the OUTPUT HI binding post, also the default setting); AUX, which is the AUX CURRENT OUTPUT binding post, or 5725A, which is the 5725A Amplifier binding posts. (The 5725A must be turned on, but not necessarily activated.)

NOTE

If AUX is selected for a 5700A configured for rear output, the error message: "Compliance voltage exceeded" will be diplayed. For rear output, use the NORMAL setting.

- The "Range" softkey selects autorange or lock for the present range. When the range is set to AUTO (the default setting), the 5700A automatically selects the lowest possible range.

- The "Setup Menus" softkey opens the setup menu.

AC Current Output 4-24.

To set an ac current output, proceed as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OFFSET] if necessary.

2. If the UUT is not connected, connect it now as described earlier in this section under "Connecting the 5700A to a UUT."

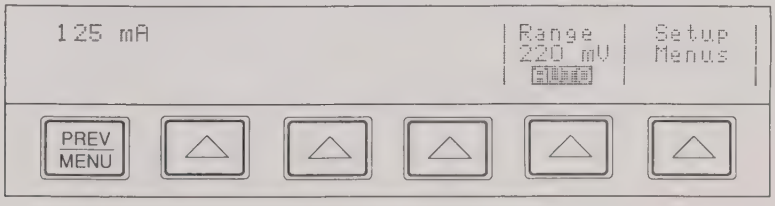
3. Set the UUT to measure ac current on the appropriate range.

4. Press up to seven numeric keys to select an amperage level.

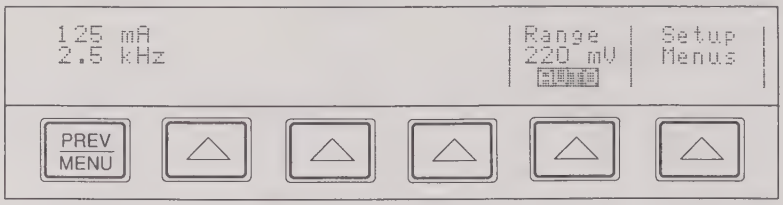
5. Press [μ] or [m] if necessary.

6. Press [A].

7. The Control Display now shows the amplitude of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 125 mA:



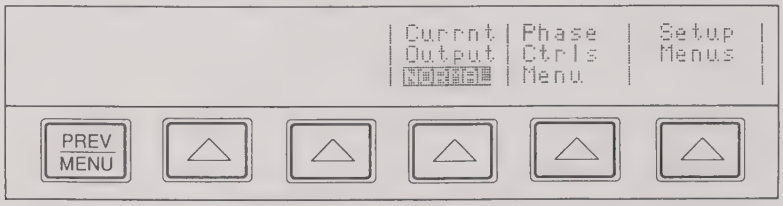
8. Press up to five numeric keys to select a frequency, followed by [k] if necessary. The Control Display now shows the amplitude and frequency of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 2.5 kHz:



9. Press [ENTER]. The 5700A clears your entry from the Control Display and copies it into the Output Display. No current is available at the output terminals, however, until you press [OPR/STBY].

10. Press [OPR/STBY] to activate the 5700A output. The UUT will now respond to the applied current.

Three softkey labels appear on the Control Display in the ac current function: "Currnt Output", "Phase Ctrls Menu", and "Setup Menus":



- The "Currnt Output" softkey selects one of three locations for current output: the OUTPUT binding post (NORMAL, which is the OUTPUT HI binding post, also the default setting); AUX, which is the AUX CURRENT OUTPUT binding post, or 5725A, which is the 5725A Amplifier binding posts. (The 5725A must be turned on, but not necessarily activated.)

NOTE

If AUX is selected for a 5700A configured for rear output, the error message: "Compliance voltage exceeded" will displayed. For rear output, use the NORMAL setting.

- The "Phase Ctrls Menu" softkey activates the front panel controls for phase output. (Instructions for setting a phase output are under "Phase Output," further on in this section.)

- The "Setup Menus" softkey opens the setup menu.

NOTE

The 5700A stays in the ac function after you enter a non-zero frequency. If you want to change back to dc, simply enter a frequency of 0 Hz or a signed current magnitude.

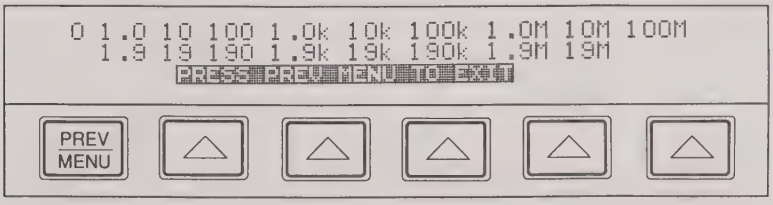
Resistance Output 4-25.

In the resistance function, the 5700A supplies your choice of 17 standard resistance values or a short at the output terminals. You can display a table of the available resistance values on the Control Display. To display the table, proceed as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.

2. Press [1], [Ω], then [ENTER].

3. Press the "List Table Values" softkey. The 5700A shows a table of available resistance values on the Control Display:



To select a resistance output, proceed as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.

2. If the UUT is not connected, connect it now as described previously in this section under "Connecting the 5700A to a UUT."

3. Set the UUT to read resistance on the appropriate range.

4. Press the numeric keys of the nominal resistance.

5. Press [k] or [M] if necessary.

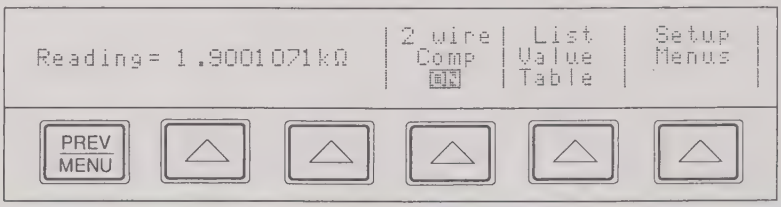
6. Press [Ω].

7. Press [ENTER]. If you entered a resistance value that is unavailable (as in the following example of 490 ohms), the Control Display prompts you to try again. If you want to review the available resistance values, press the "List Value Table" softkey.

8. After you specify a valid resistance and press [ENTER], the 5700A clears your entry from the Control Display and shows the characterized (true) resistance value on the Output Display and on the Control Display.

9. Press [OPR/STBY]. This resistance is now available at the output terminals.

Depending on the value set, two or three softkey labels appear on the control display in the resistance function: "2 wire Comp", "List Value Table", and "Setup Menus":



- The "2 wire Comp" softkey only appears for resistance values of 19 kΩ or lower. It turns on and off internal two-wire lead compensation circuitry. (See the full explanation on its use below.)

- The "List Value Table" softkey lists the nominal resistance values that the 5700A can produce.

- The "Setup Menus" softkey opens the setup menu.

In the resistance function, two features are available to enhance accuracy: four-wire sensing and two-wire compensation. Two-wire compensation works with either a two-wire connection or a four-wire connection to a two-wire ohmmeter. A full explanation follows:

Four-wire connection is available for all resistance values except 100 MΩ. To activate four-wire resistance, press [EX SNS] so that the indicator lights. (Figure 4-4A shows the four-wire connection.)

For calibrating a meter with a two-wire resistance mode such as a typical handheld DMM, refer to Figures 4-4B through 4-4D. For resistances of 19 kΩ or lower in two-wire mode, compensation circuitry inside the 5700A is available to remove errors introduced by resistance in the path between the front panel terminals and the precision resistor. The softkey label "2 wire Comp" appears on the Control Display when you select resistances of 19 kΩor lower. This softkey allows you to disable and enable the compensation circuitry.

Depending on how you connect the meter, you can use two-wire compensation referenced at the UUT terminals (Figure 4-4C) or at the 5700A binding posts (Figure 4-4D). See "Resistance Output" for information on turning on and off two-wire compensation circuitry.

Figure 4-4B shows a meter connected in a two-wire connection with the two-wire compensation circuitry turned off. Use this configuration only if lead resistances are insignificant. For a two-wire connection, press [EX SNS] so that the indicator is off.

For resistances where uncompensated lead resistances are significant, use the two-wire compensation circuit and the connection in Figure 4-4C or 4-4D. Use the connection in Figure 4-4C if you want to calibrate the meter referenced at its terminals. Use the connection in Figure 4-4D if you want to calibrate the meter referenced at the ends of its test leads.

Wideband AC Voltage Output (Option 5700A-03) 4-26.

To set an output from the Wideband AC Module (Option 5700A-03), proceed from [RESET] or the power-up state as follows:

1. Make sure the 5700A is in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.
2. If the UUT is not connected, connect it now as described previously in this section under "Connecting the 5700A to a UUT."
3. Set the UUT to read ac voltage on the appropriate range.
4. Press [W BND].
5. Press the numeric keys for the desired output, expressed as voltage or a dBm level.

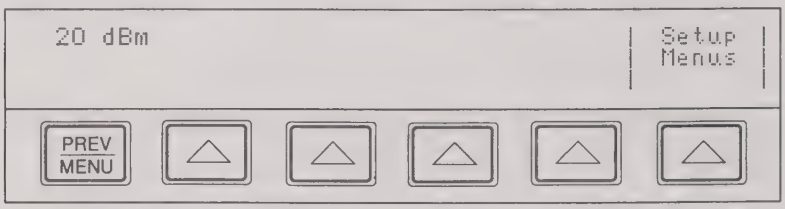
In the Wideband AC function, dBm means decibels above or below 1 mW, calculated for a 50Ω load. The formula to calculate dBm is 10 log (power in mW). For example, if 3.0V is supplied to a 50Ω load, the dBm level is:

10 log (180.0 mW) = 22.5527 dBm

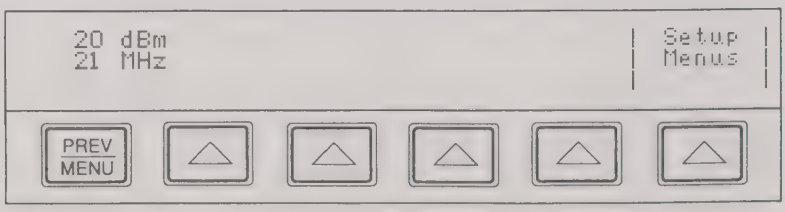
If you switch to standard ac output, but keep dBm as the displayed units, the dBm value will change. The value changes because dBm is calculated for a 600Ω load in the standard ac output function. Using the same voltage level as in the previous example, if you switch to standard ac output, the dBm level changes to:

10 log (15.0 mW) = 11.7609 dBm.

6. If you want to enter a negative dBm value, press [+/-].
7. Press [μ] or [m] if necessary.
8. Press [V] for volts or [dBm] for volts expressed as dBm.
9. The Control Display now shows the amplitude of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 20 dBm:



10. Press up to five numeric keys to select a frequency, followed by [k] or [M] if necessary. The Control Display now shows the amplitude and frequency of your entry. If you made an entry error, press [CE] to clear the display, then reenter the value. The following illustration of the Control Display assumes an entry of 21 MHz:



9. Press [ENTER]. The 5700A clears your entry from the Control Display and copies it into the Output Display. No voltage is available at the WIDEBAND Type "N" coaxial connector however, until you press [OPR/STBY].

10. Press [OPR/STBY] to activate the 5700A output. The UUT will now respond to the applied voltage.

NOTE

To deactivate the Wideband AC Module and switch to another output function, press [W BND]. *If you are sourcing an ac voltage or dBm level within the range of the standard ac voltage output mode, that value is selected. Otherwise, the Output Display reads 0 mV (dc).*

When you are using units of dBm and switching between wideband and standard ac voltage output, the amplitude changes. This change occurs because for the wideband function, decibel levels are computed for a 50Ω load, and for the standard ac function, decibel levels are computed for a 600Ω load.

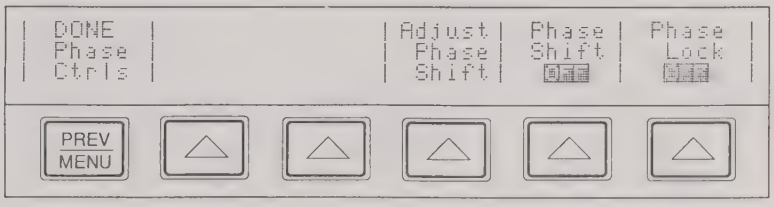
Variable Phase Output 4-27.

A variable-phase signal of nominally 2.5V rms is available at the rear panel BNC connector labeled VARIABLE PHASE OUT when sourcing ac V, wideband voltage, or ac current outputs. The phase of this signal with respect to the main output signal is continuously adjustable from -180° to +180° in 1° increments. The rotary knob and softkeys adjust the phase of this signal, after calling up the phase controls menu using a softkey. The Control Display shows the phase of the phase output signal as a number and a cursor on a linear scale graduated in 90° steps from -180° to +180°.

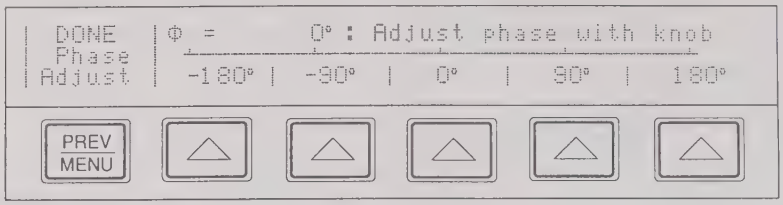
To set and adjust a phase output, proceed as follows:

1. Set an ac voltage or current output as described under "AC Voltage or Current Output."

2. Press the "Phase Ctrls Menu" softkey. The Control Display appears as shown below:



3. Press the "Adjust Phase Shift" softkey. A cursor on the display shows the phase shift of the variable phase output signal:



4. To quickly select a multiple of 90°, press the appropriate softkey.

5. To select a phase output between -180° and 180° (including all intermediate positions), turn the rotary knob to move the cursor to the desired position on the scale. The Control Display shows the phase angle in ± degrees.

6. Press the "DONE Phase Adjust" softkey.

7. Press the "Phase Shift" softkey so "ON" appears. The "ΦSHF" annunciator lights indicating that variable phase output is on. The variable-phase reference signal stays on after you leave the phase controls menu, and even when you switch between current and voltage. It is turned off when you switch to a dc or ohms function.

8. To reactivate the numeric keypad for controlling the output, press the "DONE Phase Ctrls" softkey.

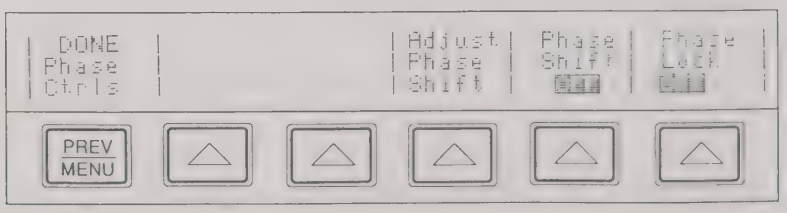
PHASE LOCKING TO AN EXTERNAL SIGNAL 4-28.

The phase-lock feature locks the calibrator's main output signal in phase with an external signal (1 to 10V rms at 10 Hz to 1.2 MHz) applied to the rear panel PHASE LOCK IN BNC connector. You can use this feature with ac V, wideband voltage, or current outputs, and combine it with variable phase output. You access the softkey that turns on phase locking through the phase controls menu. To lock onto an external signal, proceed as follows:

1. With the external signal source turned off, connect a coaxial cable between the external signal source and the rear panel PHASE LOCK IN BNC connector.

2. Set an ac voltage or current output as described under "AC Voltage or Current Output."

3. Press the "Phase Ctrls Menu" softkey. The Control Display appears as shown below:

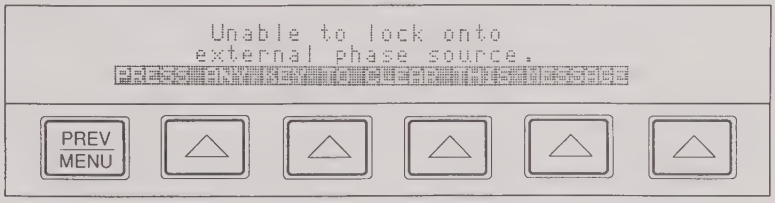


4. Turn on the external signal source.

5. Set the 5700A frequency to within 2% of the external source frequency.

6. Press the "Phase Lock" softkey. This locks the 5700A's main output signal in phase with the external signal applied to the rear panel PHASE LOCK IN BNC connector. When phase locking is successful, the Φ LCK annunciator on the Output Display lights.

7. Observe the Control Display. If the 5700A cannot lock onto the external signal for any reason, it displays the following message:



8. To reactivate the numeric keypad for controlling the output, press [PREV MENU]. Phase locking remains active until you change the frequency or turn off phase lock using the "Phase Lock" softkey.

USING AN AUXILIARY AMPLIFIER 4-29.

You can increase the output capability of the 5700A by using an auxiliary amplifier. The 5700A has rear panel connectors that interface with four different amplifiers. Three amplifiers can be connected to the 5700A simultaneously, but only one amplifier can be designated as the voltage boost and one amplifier as the current boost in the setup menu. (And only one output can be active at a time.) Table 1-1 lists the model numbers of the amplifiers supported by the 5700A and shows the ranges and functions supported by each amplifier. The choice of active amplifier and be changed dynamically in a remote system, since such systems can control any front panel function.

During boost operation, you operate the amplifier from the 5700A front panel. The 5700A computes and supplies the correct excitation voltages to drive the amplifier. The Output Display on the 5700A always shows the actual output of the amplifier, not the excitation output of the 5700A. In general, the amplifier is activated automatically by selecting an output amplitude only available in its range. In some cases, [BOOST] is used to activate and deactivate the selected amplifier. Refer to the following text for specific operation instructions for each type of amplifier.

5725A Amplifier Output 4-30.

WARNING

BOOSTED VOLTAGE OPERATION PRODUCES HIGH VOLTAGE AT HIGHER CURRENT LEVELS THAN NORMALLY AVAILABLE FROM THE CALIBRATOR. DURING BOOSTED VOLTAGE OPERATION, THE POTENTIAL RISK OF INJURY OR FATAL ACCIDENT IS GREATER THAN DURING NORMAL OPERATION.

NOTE

Refer to the 5725A Instruction Manual for setup and installation instructions.

The 5725A Amplifier boosts ac voltage and both ac and dc current. Proceed as follows to set a boosted output from the 5725A Amplifier:

1. Install the 5725A if you have not already done so as described in the 5725A Instruction Manual.

2. If the "Boost Amp Types" setting in the setup menus has been changed from the default, select the 5725A for boost operation as described at the beginning of this section.

3. Make sure the 5700A and 5725A are in standby (STANDBY annunciator lit). Press [OPR STBY] if necessary.

4. If the UUT is not connected, connect it now as described earlier in this section under "Connecting the 5700A to a UUT." Note that for boosted current, you connect to the 5725A binding posts, and for boosted voltage, you connect to the 5700A binding posts.

5. Set the UUT to read the appropriate quantity.

6. Enter the desired output value as described under "Setting the Output." Current entries beyond the standard range of the 5700A automatically select the amplifier. Voltage entries in the 220-1100V range automatically select the amplifier. Note that the 5725A takes over the 1100V range of the 5700A.

7. Boosted voltage output is available at the front or rear panel of the 5700A (depending on which set of terminals is active). Boosted current output is available at the front panel of the 5725A Amplifier. When the 5725A binding posts are selected, the Control Display announces the output location. If your entry has caused a change of output location, you must press [OPR STBY] to activate the amplifier.

8. When the "Range" softkey is set to "AUTO", the amplifier automatically turns off whenever a current level within the range of the 5700A is set. Setting the "Range" softkey to "LOCKED" disables this auto shut-off, so you can use the amplifier at lower current levels.

NOTE

You can have the 5725A source a current below 2.2A to take advantage of the amplifier's higher compliance voltage. To do so, press the "Range" softkey to lock onto the 11A range when the 5700A is set for over 2.2A, or set the lower current and press BOOST *then* OPR STBY *to turn on the amplifier.*

9. To deactivate the amplifier, press BOOST again.

5205A or 5215A Precision Power Amplifier Output 4-31.

WARNING

BOOSTED VOLTAGE OPERATION PRODUCES HIGH VOLTAGE AT HIGHER CURRENT LEVELS THAN NORMALLY AVAILABLE FROM THE CALIBRATOR. DURING BOOSTED VOLTAGE OPERATION, THE POTENTIAL RISK OF INJURY OR FATAL ACCIDENT IS GREATER THAN DURING NORMAL OPERATION.

NOTE

If you are using an early 5205A with serial number 2061000 or below, the dc voltage function may not work. If so, request Product Change Notice #150 from a Fluke Technical Service Center.

NOTE

Refer to the amplifier instruction manual for UUT connection instructions.

The 5205A Precision Power Amplifier boosts ac and dc voltage. The 5215A Precision Power Amplifier boosts ac voltage only. Proceed as follows to set a boosted output using the 5205A or 5215A:

1. Install the amplifier if you have not already done so as described in its instruction manual.

2. Connect the amplifier to the 5700A if you have not already done so as described in Section 2.

3. If the "Boost Amp Types" setting in the setup menus has not yet been changed, select the 5205A or 5215A for voltage boost operation as described at the beginning of this section.

4. Make sure the 5700A and 5205A or 5215A are in standby (STANDBY annunciators lit). Press OPR STBY if necessary.

5. Connect the amplifier output cable to the UUT as described in the 5205A or 5215A Instruction Manual.

WARNING

TO AVOID ELECTRIC SHOCK AND DAMAGE TO THE VOLTAGE GUARD CIRCUIT, MAKE SURE THE ACTIVE OUTPUT LOW CABLE IS CONNECTED TO GROUND AT SOME POINT IN THE SYSTEM. FOR MORE INFORMATION REFER TO THE 5205A or 5215A INSTRUCTION MANUAL.

7. Set the UUT to read the appropriate quantity.

8. Enter the desired voltage output value as described under "Setting the Output." The amplifier is selected automatically when the amplitude-frequency combination of the entry is beyond the standard range of the 5700A.

9. To activate the amplifier, press [OPR STBY]. The boosted voltage output is available at the amplifier output cable, and its value is displayed on the 5700A Output Display.

NOTE

You can have the 5205A or 5215A source a voltage that is within the range of the 5700A to take advantage of the amplifier's higher load capability. To turn on the amplifier for lower ranges, press [BOOST].

10. To deactivate the amplifier, press [BOOST] again.

NOTE

Refer to the 5205A or 5215A Instruction Manual for load limits and other amplifier output specifications.

5220A Transconductance Amplifier Output 4-32.

The 5220A Transconductance Amplifier boosts current. To set a boosted output using the 5220A Transconductance Amplifier, proceed as follows:

1. Install the amplifier if you have not already done so as described in its instruction manual.

2. Connect the amplifier to the 5700A if you have not already done so as described in Section 2.

3. If the "Boost Amp Types" setting in the setup menus has not yet been changed, select the 5220A for current boost operation as described at the beginning of this section.

4. Make sure the 5700A and 5220A are in standby (STANDBY annunciators lit). Press [OPR STBY] if necessary.

5. Connect the UUT to the binding posts of the amplifier as described in the 5220A Instruction Manual.

6. Set the UUT to read the appropriate quantity.

7. Enter the desired current output value as described under "Setting the Output." The amplifier is selected automatically when the amplitude of the entry is greater than 2.2A.

NOTE

You can have the 5220A source a current that is within the range of the 5700A to take advantage of the amplifier's higher compliance voltage. To keep the amplifier on for lower ranges, set the "Range" softkey to "LOCK" when on the 20A range, or set the lower current and press [BOOST] to turn on the amplifier.

8. Enter the desired output value as described under "Setting the Output."

9. To activate the amplifier, press [OPR STBY]. The boosted current output is available at the amplifier binding posts, and its value is displayed on the 5700A Output Display.

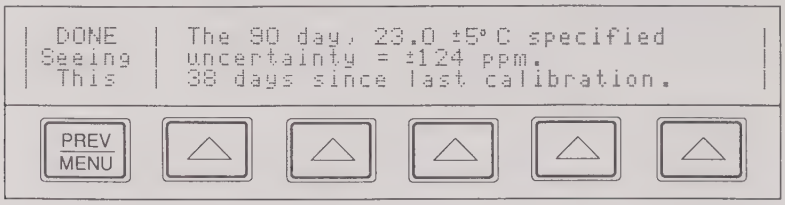
10. To deactivate the amplifier, press [BOOST] again.

NOTE

Refer to the 5220A Instruction Manual for inductive load limits and other amplifier specifications.

CHECKING THE 5700A UNCERTAINTY SPECIFICATION 4-33.

At any time during front panel operation, you can display the uncertainty specification of the present output of the 5700A by pressing SPEC To return to normal operation, press PREV MENU . The Control Display could appear as follows after you press SPEC :



ERROR MODE OPERATION 4-34.

The output adjustment controls (arrow keys and the rotary knob) are used to adjust the output of the 5700A incrementally (except in the resistance function). While this happens, the Control Display computes and displays the difference between the adjusted output and the reference level in ±% or ±ppm (parts per million). The reference level is the original output setting before you adjusted it. When this capability is used to adjust the output until the UUT reads correctly, the displayed difference is the UUT error for that output setting. The error is displayed in ±% unless it is ±20 ppm or less.

For example, suppose you set the 5700A to output 10.00000V, and the UUT reading is high. To determine the error, use the output adjustment controls to adjust the 5700A until the UUT reads 10.0000V. If, for example, the 5700A Output Display now reads 9.993900, the 5700A calculates and displays a UUT error of +0.0610% on the Control Display.

The 5700A uses this formula to calculate the UUT error:

$$\text{Error} = \frac{\text{Reference} - \text{Final Output}}{\text{Reference}} \times 100\%$$

The rotary knob is also a convenient way to change the frequency during ac voltage testing. To adjust frequency in error mode, for example when testing a meter's flatness, press AMPL FREQ . The 10 Hz digit of the frequency line is highlighted. Press ← twice. Now when you turn the knob, the output frequency increases or decreases 1 kHz per knob click.

Error Mode Overview 4-35.

The Error Mode Overview explains how to use error mode in general. Following the overview, a step-by-step procedure explains how to use this mode to read UUT error for each of the 5700A output functions.

ENTERING ERROR MODE 4-36.

Activate error mode by rotating the rotary knob, pressing an arrow key, or pressing [AMPL FREQ]. When you enter error mode, the starting value is the reference from which errors are computed. A new reference is established when you exit and reenter error mode (see Table 4-3 for a summary).

EXITING ERROR MODE 4-37.

Table 4-3 lists the actions that cause the 5700A to exit error mode.

Table 4-3. Keys That Exit Error Mode

KEYS	ACTION
[ENTER]	Returns to the previous reference value.
[+/-] + [ENTER]	Establishes a new reference.
A new keypad entry + [ENTER]	Establishes a new reference.
[NEW REF]	Establishes the present output as a new reference.
[X 10]	Sets the 5700A to ten times the reference value and establishes a new reference.
[÷10]	Sets the 5700A to one-tenth the reference value and establishes a new reference.
[OFFSET]	Identifies the present output as a zero-scale endpoint for scaling and establishes 0.0 as the new reference.
[SCALE]	Identifies the present output as a full-scale endpoint for scaling and causes the display to show scale error.
[RESET]	Returns to the power-up state.
The "Setup Menus" softkey	Opens the setup menu.

USING ERROR MODE 4-38.

When you enter error mode from any output function except resistance, the least significant digit on the Output Display is highlighted. Entering error mode by pressing [AMPL FREQ] selects the frequency line for adjustment first (but only if the frequency is not zero).

When you turn the rotary knob, the highlighted digit increments or decrements. Turning the knob clockwise makes the number more positive; turning the knob counterclockwise makes the number more negative. As you increment a digit past 9 or decrement a digit past 0, the adjacent digit carries. [←] and [→] select digits to the right and left, and [AMPL FREQ] selects the upper line (amplitude) and lower line (frequency).

If you attempt to adjust the output beyond the capability of the 5700A, the 5700A beeps and does not allow the change.

You can quickly verify accuracy of different ranges of a UUT by pressing [x10] and [÷10]. When you are in error mode and you press these keys, the 5700A output and the new reference are set to 10 times or one tenth the previous reference value.

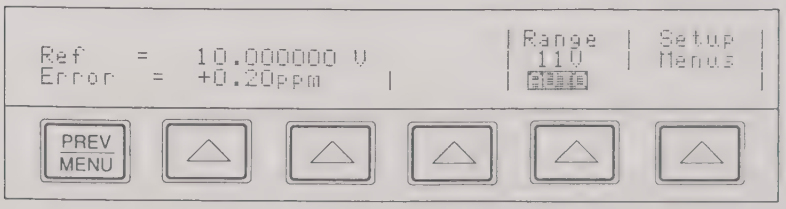
In the resistance output function, the edit controls produce a display of the UUT error in a similar way, except the output of the 5700A does not change as you turn the knob. Instead, a reading on the Control Display changes, allowing you to match it to the reading on the UUT. As you change the reading, the 5700A computes and displays UUT error.

Reading the UUT Error: AC and DC Voltage and Current Output 4-39.

Proceed as follows to read the error of the UUT in the ac and dc voltage and current output functions:

1. Set the desired calibration voltage or current, as previously described under "Setting the Output."

2. Use the output adjustment controls as required to achieve a reading on the UUT equal to the original entry on the 5700A. To increment or decrement a higher-order digit, press [←]. As you approach the reference value, work progressively back towards the LSD (least-significant digit) on the 5700A Output Display as necessary by pressing [→]. You only need to go one digit past the LSD of the UUT; digits below that are beyond the resolution of the UUT. The UUT error appears on the Control Display as shown: (This example assumes that the 5700A is in the dc voltage function.)



Reading the UUT Error: Resistance Output 4-40.

Proceed as follows to read the error of the UUT in the resistance function:

1. Set the desired resistance output as described under "Setting the Output."

2. Use the output adjustment controls as required to achieve a reading on the Control Display (illustrated below) equal to the reading on the UUT. To adjust a higher-order digit, press [←]. As you approach the reference value, work progressively back towards the LSD (least-significant digit) on the 5700A Control Display as necessary by pressing [→]. You only need to go one digit past the LSD of the UUT; digits below that are beyond the resolution of the UUT.

INTRODUCTION TO OFFSET, SCALE, AND LINEARITY ERRORS 4-41.

The performance of a DMM or meter can be plotted as a graph of input stimulus and meter reading. For a perfect meter, the graph of the input stimulus would exactly match the graph of the reading.

The 5700A measures and displays the following three types of UUT errors:

- Offset Error
- Scale Error
- Linearity Error

Offset Error 4-42.

Offset error can be measured directly by finding the 5700A output that causes a meter reading of 0V. This error is called an offset because it reflects a fixed error that is present in all meter output readings. For example, if a meter reads 0V when -1.3 mV is applied, the meter has an offset error of +1.3 mV. Figure 4-7 illustrates this example.

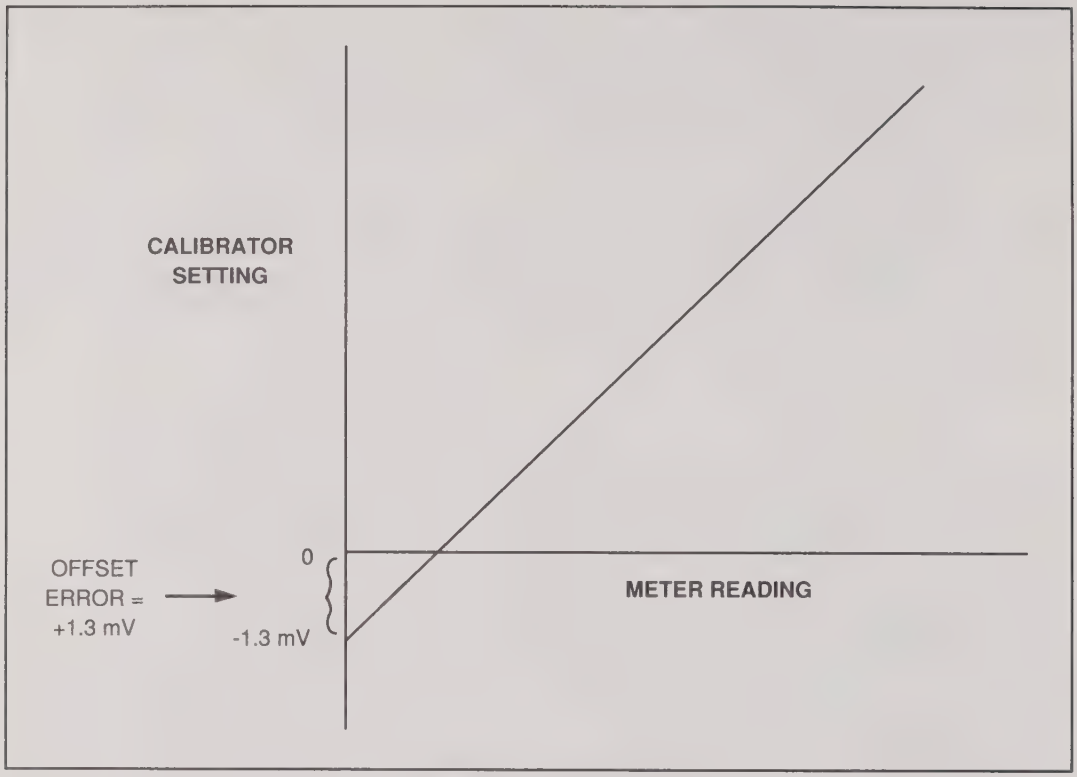


Figure 4-7. Offset Error

Scale Error 4-43.

Scale error, also called gain error, results when the slope of the meter's response curve deviates from one. A meter with only scale error (no offset or linearity error), will read 0V with 0V applied, but something other than 10V with 10V applied. For example, if a meter reads 19.900V when 19.903V is applied, the meter has a scale error of -3 mV. To isolate scale error, offset error must first be subtracted. Scale error is then simply the error measured near the full-scale endpoint, or:

$$\text{Scale error} = \frac{\text{(Reference full-scale) - (Adjusted 5700A setting)}}{\text{(Reference full-scale)}}$$

Where "adjusted 5700A setting" is the adjusted output (using the knob) that results in the UUT correctly reading "nominal full-scale". Select a point just down from the UUT full-scale endpoint for nominal full-scale. This keeps the UUT from ranging while you make adjustments. For example, you might use 19.9V as the nominal full-scale for a UUT that ranges at 20V.

The example in Figure 4-8 assumes no offset error. The formula for scale error yields:

$$= \frac{19.9 - 19.903}{19.9} = -0.000151 = -0.0151\%$$

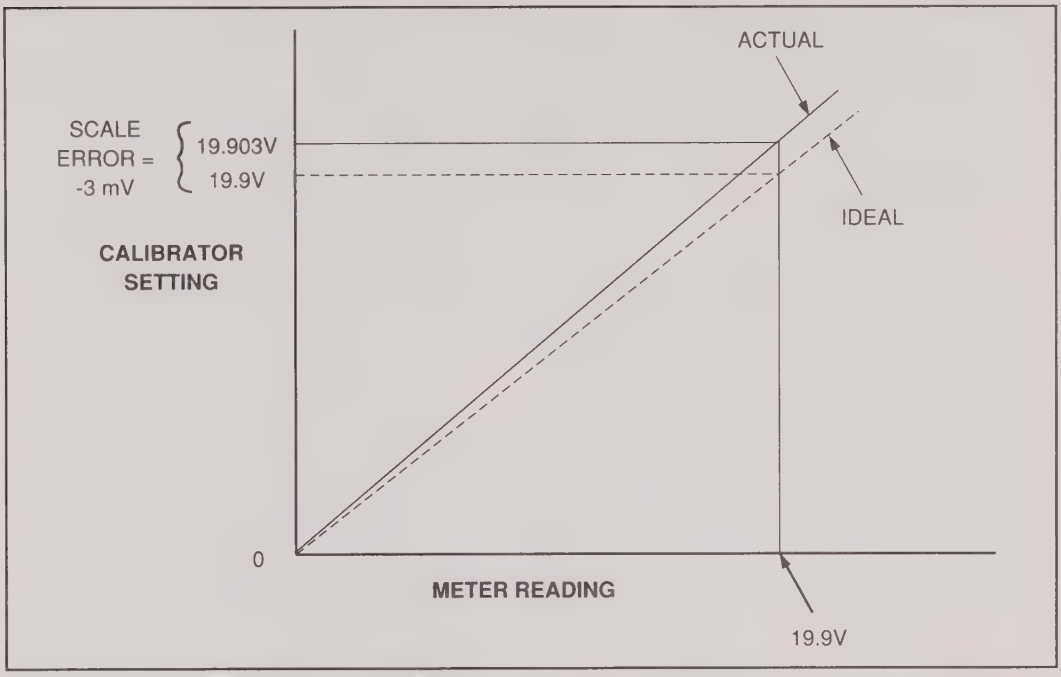


Figure 4-8. Scale Error

Linearity Error 4-44.

Linearity error occurs when the response curve of a meter deviates from a straight line. This type of error is measured by fixing zero and near-full-scale endpoints on the response curve, drawing a line through the points, then measuring how far the meter response deviates from the straight line at various points. The error value is computed relative to the selected full-scale point. The formula for linearity error is:

$$\text{Linearity error} = \frac{\text{(Nominal setting) - (Adjusted 5700A setting)}}{\text{(Nominal full-scale)}}$$

Where the "nominal setting" is calculated by subtracting the offset error and a proportional part of the scale error.

Figure 4-9 illustrates linearity error with both offset and scale errors assumed to be zero. Linearity error in this example works out to:

$$= \frac{10.0 - 9.993}{19.9} = 0.000352 = +0.0352\%$$

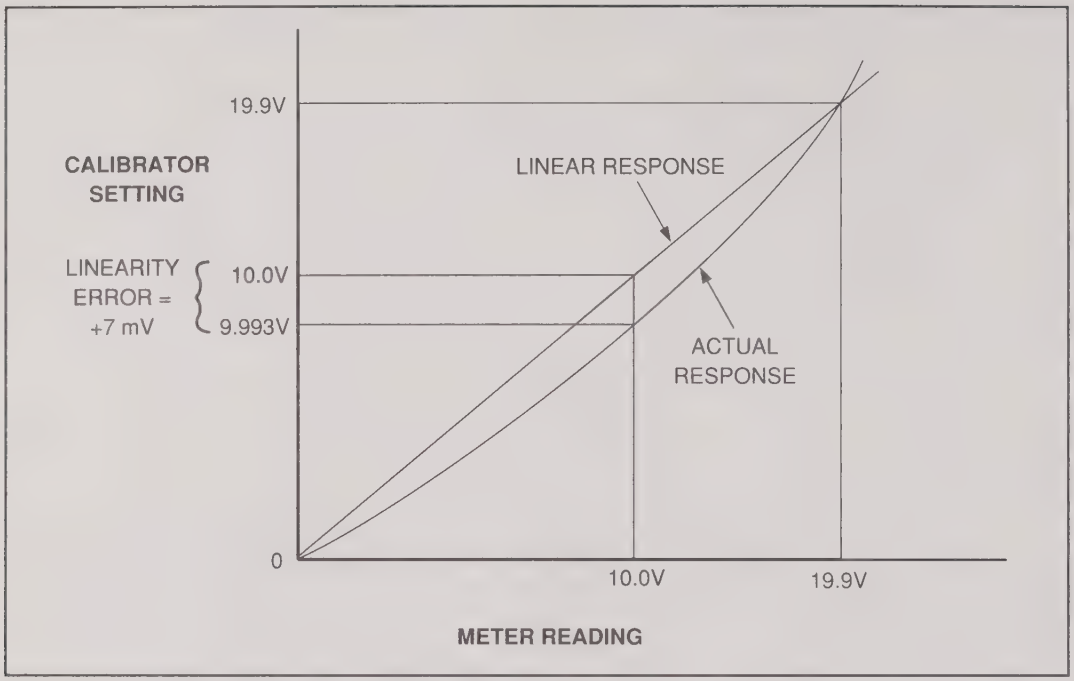


Figure 4-9. Linearity Error

Combining the Error Types 4-45.

The actual error of a meter is the combination of all three types of errors. The 5700A uses [OFFSET] and [SCALE] to allow you to separately display all three types of errors directly, without having to do any calculation.

PROGRAMMING AN OFFSET 4-46.

You can use [OFFSET] when in the dc voltage or current function any time you want to offset the 5700A output by a fixed amount. After you establish an offset, it is subtracted from all later keyboard entries to compensate for a UUT's offset error. You turn off this offset by pressing [OFFSET] again. Both the offset value and the keypad-entered reference value are shown on the Control Display. The Output Display shows the true output value.

The [OFFSET] key may be used to establish a zero-scale endpoint, which you can then use with [SCALE] to check the linearity of a UUT. (See the example under "Linearity Checking Using Offset and Scale.")

To program an offset, proceed as follows:

1. Set the 5700A to output 0 mV dc in operate mode. The easiest way to do this is to press [RESET], then press [OPR/STBY].

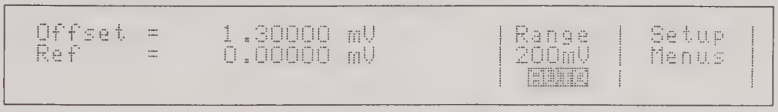
2. Adjust the 5700A output with the rotary knob (and arrow keys if necessary) until the UUT reads 0V.

3. Press [OFFSET]. This stores the output value as the offset value.

The 5700A output value is now 0V minus the offset value, in this example, the 1.3 mV output value is shown on the Output Display. The 5700A reference value is set to 0V. The reference value is shown on the top line of the Control Display. The offset value is shown on the second line of the Control Display. After step 2, the Control Display and Output Display look like this:

Output Display

Control Display



If you enter a new value, the offset value is subtracted from the new value to create the new output. The newly entered value becomes the new reference value shown on the middle line of the Control Display. For example, if you enter 1V, the Output Display shows +0.9987000V while the Control Display shows "Ref = 1.0000000V". The offset value remains in effect until you press OFFSET again, turn off the power, select a different output function (for example, changing from voltage to current output), or press "Setup Menus".

PROGRAMMING A SCALE FACTOR 4-47.

You can use the SCALE key in ac and dc voltage and current functions to apply a scale factor to subsequent outputs. After you establish a scale factor, the correct proportion of it is applied to all subsequent entries to compensate for a UUT's scale error. You turn off this scale factor by pressing SCALE again. Both the scale error and the keypad-entered value are shown on the Control Display. The Output Display shows the true output value.

The SCALE key may be used to establish a reference full-scale endpoint, which you can use with OFFSET to check the linearity of a UUT. (See the example under "Linearity Checking Using Offset and Scale".)

To program a scale factor, proceed as follows:

1. Set the 5700A to output a level just below the UUT full-scale endpoint. For example, you might use 19.9V for a UUT that ranges at 20V.

2. Adjust the 5700A output with the rotary knob (and arrow keys if necessary) until the UUT reads the selected output level correctly (19.9V in this example).

3. Press SCALE . This stores a scale factor that would apply this adjustment if this output level were selected again.

Subsequent 5700A output values will be scaled by this factor. Using the example of Figure 4-8, the meter reading was 3 mV low at 19.9V. To compensate, the 5700A was adjusted to 19.003V to get a reading of 19.9V on the meter. Note that the calibrator is adjusted in the opposite direction of the meter's scale error. So, a factor computed in the following equation is applied to subsequent calibrator output settings until SCALE is cleared:

$$1 - \left(\frac{19.9\text{V} - 19.903\text{V}}{19.9\text{V}} \right) = 1.000151$$

Extending this example, if you now set the 5700A to 10V, the actual output (showing on the Output Display) is 10.00151V.

LINEARITY CHECKING USING OFFSET AND SCALE 4-48.

Using the offset and scaling features of the 5700A, you can remove a UUT's offset and scale errors to isolate and display linearity error. The following procedure is an example that uses OFFSET and SCALE to quickly determine both scale and linearity error of a 4 ½-digit DMM. In this example, the DMM is set to the 20V dc range, and the 5700A is connected to the DMM. Figure 4-10 illustrates all three types of errors that are detected by the 5700A in this example. The numbers in the graph correspond to the conditions encountered in the example.

1. Set the 5700A to 0 mV in standby. The displays change to:

Output Display	Control Display	UUT (DMM) Display
0.000000 mV		+ 0.0013 V

2. Use the output adjustment controls (the rotary knob and arrow keys) to adjust the 5700A output for a reading of 0V on the DMM. The displays change to:

Output Display	Control Display	UUT (DMM) Display
- 1.300000 mV	Ref = 0.00000mV Error > +999.9999%	0.0000 V

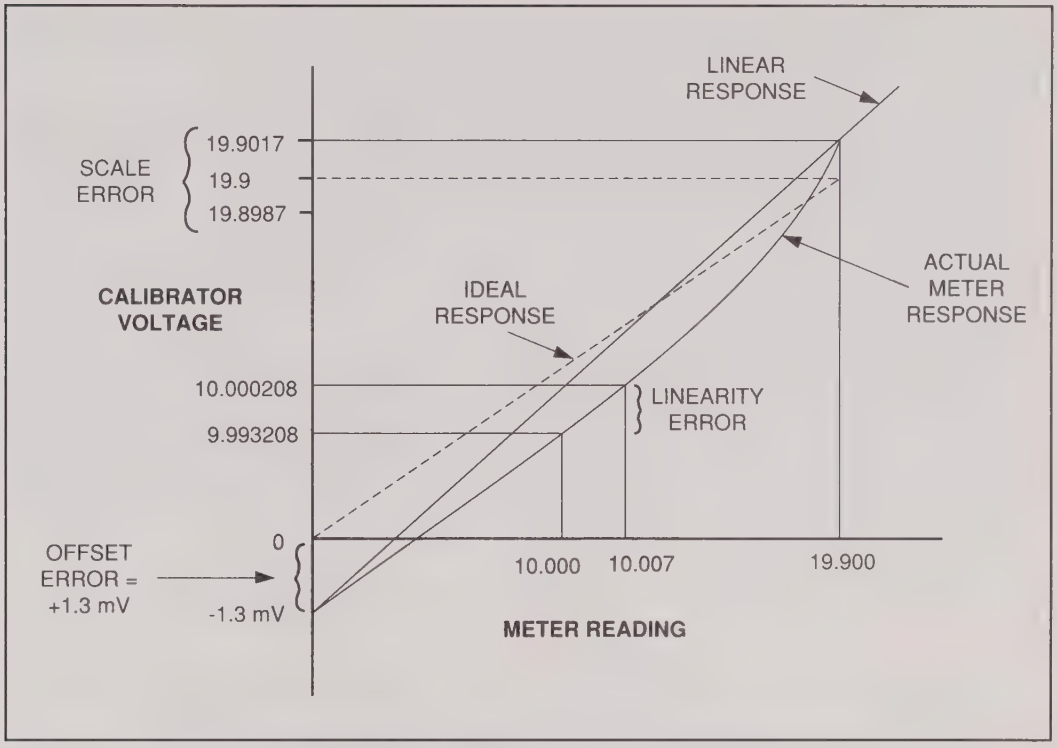


Figure 4-10. Meter Response vs Stimulus

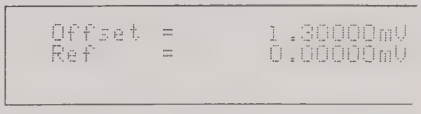
NOTE

The message "Error >+999.9999%" occurs because in this case the reference voltage is 0.

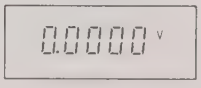
3. Press OFFSET to identify this as the DMM zero-scale end point. The displays change to:

Output Display

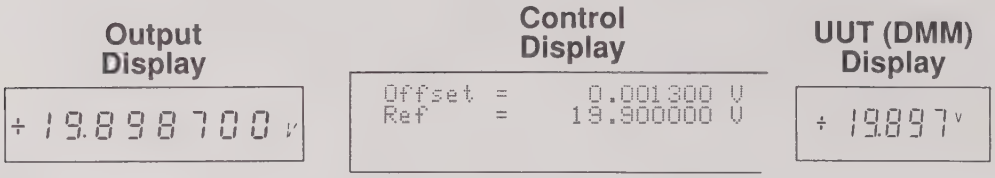
Control Display



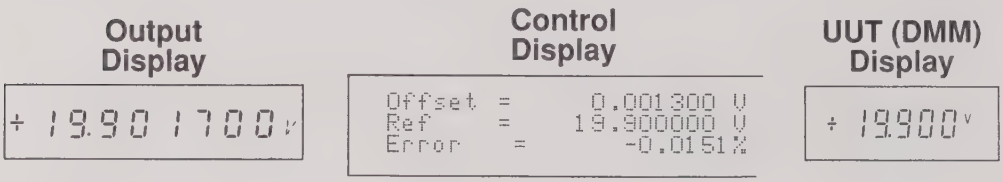
UUT (DMM) Display



4. Use the numeric keypad to set the 5700A to a point near the end of the DMM range. (This example uses 19.9V.) The displays change to:

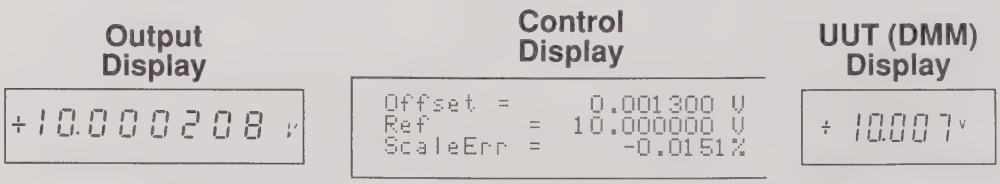


5. Use the output adjustment controls to adjust the 5700A output for a reading of 19.9V (the reference value) on the DMM. The displays change to:



6. Press [SCALE] to identify this as the full-scale endpoint for the DMM range.

7. To check the linearity error of the DMM, select an output at a linearity checkpoint somewhere in the middle of the range, such as 10V. Entering 10V changes the displays to:



The 10.000208V output setting is calculated by the 5700A using the following equation:

$$\text{Scale factor} = 1 - \left\{ \frac{19.9 - 19.903}{19.9} \right\} = 1.0001508$$

This is applied to 10V to yield the following:

10V x 1.0001508 = 10.001508V

The 1.3 mV zero offset is then subtracted:

$$\begin{array}{r} 10.001508\text{V} \\ -0.0013\ \text{V} \\ \hline 10.000208\text{V} \end{array}$$

8. Use the output adjustment controls to adjust the 5700A output for a reading of 10.0V (the reference value) on the DMM. The displays change to:

Output Display	Control Display	UUT (DMM) Display
+ 9.993208 V	Offset = 0.001300V Ref = 10.000000V LinError = +0.0352%	+ 10.000 V

The Control Display now shows that the DMM scale error at 19.9V is -0.0151%, and the DMM linearity error at 10V is +0.0352%.

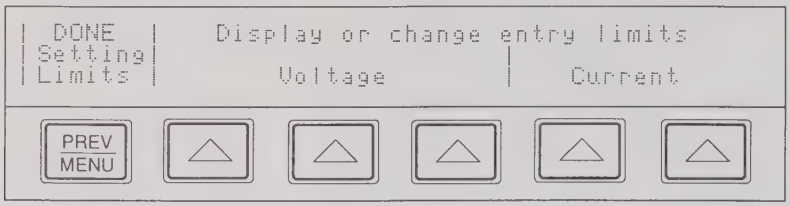
SETTING OUTPUT LIMITS 4-49.

An output limit feature is available to help prevent accidental damage to a UUT from overcurrent or overvoltage conditions. This feature allows you to preset the maximum positive and negative allowable voltage or current output. Entry limits you set prevent any input greater than the limit from being activated by entry through the front panel keys or the output adjustment controls. Positive limits for voltage and current set the limits for ac voltage and current. Default entry limits after power-up or [RESET] are the specified maximum and minimum for each output function.

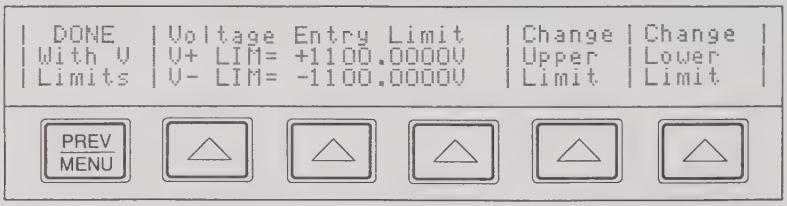
Setting Voltage and Current Limits 4-50.

To set voltage and current entry limits, proceed as follows from [RESET], the power-up state, or any direct operation menu:

1. Press [LIMIT]. The display changes to:



2. Press one of the softkeys under the label "Voltage". The display changes to:



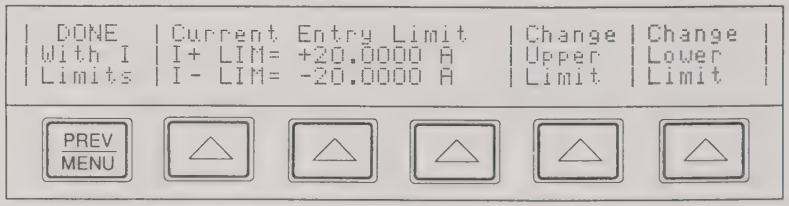
3. Press the "Change Upper Limit" or the "Change Lower Limit" softkey, then press the numeric keys for the desired voltage limit and [μ], [m], or [k] if necessary, followed by [ENTER].

NOTE

The upper voltage limit sets the limits for both dc and ac voltage.

4. Press [PREV MENU].

5. To display or change the current entry limits, press one of the softkeys under the label "Current". The display changes to:



6. Press the "Change Upper Limit" or the "Change Lower Limit" softkey, then press the numeric keys for the desired current limit and [μ], [m], or [k] if necessary, followed by [ENTER].

NOTE

The upper current limit sets the limit for both dc and ac current.

7. Press [PREV MENU] twice.

SAMPLE APPLICATIONS 4-51.

Sample methods to approach a few selected applications are provided here. Included are the following:

- Calibrating a 70 Series 3-½ digit handheld multimeter
- Calibrating an 8840A Series 5-½ digit multimeter
- Testing the flatness of a wideband voltmeter

Calibrating a 70 Series Handheld Multimeter 4-52.

For many users, calibrating a handheld DMM is a major part of the 5700A workload. This example goes through the steps necessary to calibrate a Fluke 70 Series handheld multimeter.

NOTE

These procedures are included here as an example. The 70 Series Service Manual contains the authoritative testing and calibration procedures for 70 Series meters.

Two procedures are described here. The first tests each function and range for compliance to specifications. The second is the calibration procedure for the 70 Series meters. The 70 Series Service Manual gives instructions for disassembly and access to the pca (printed circuit assembly). You will need to access the pca for the calibration procedure.

Before connecting the 5700A to the 70 Series DMM, you need to determine what type of cables to use and whether to use internal or external guarding and sensing. This decision-making process is covered next.

CABLES 4-53.

According to the text under "Connecting the 5700A to a UUT," the 5440A-7002 Low-Thermal Cables are recommended for:

- All dc voltage
- All resistance
- AC voltage $<$ 10 kHz
- AC current $\leq$2A $\leq$10 kHz
- DC current $\leq$2A

All the 70 Series tests fall into these categories, so you should use the Low-Thermal Cables. However, the thermal emf errors that the Low-Thermal cables are designed to reduce are not significant when calibrating a 3-½ digit meter. If you have the Low-Thermal Cables, use them. If you do not, you can use ordinary insulated test leads.

GUARDING 4-54.

Because the 70 Series DMMs are battery operated, their inputs have no connection to earth ground. Therefore, setting the 5700A to internal guard is appropriate.

SENSING 4-55.

External sensing is required only when the voltage drop in the cables is significant. The following data determines the significance of the voltage drop in the cables:

- The input impedance of the 70 Series DMMs is 10 MΩ.
- The total resistance of the Model 5440A-7002 Low-Thermal Cables is 30 mΩ.
- The basic dc voltage accuracy of the most accurate of the 70 Series, the Model 77, is 0.3%.

  The percentage of error caused by voltage drop in the cables is:

  .3 x 100/10,000 = 0.003%, or 1/100th of the accuracy of the Model 77.

  This voltage drop is not significant, so a two-wire connection (Internal Sense) is appropriate.

TESTING THE METER

4-56.

You can use the error mode feature of the 5700A to test the meter. To verify that all ranges of all functions are within specifications, proceed as follows:

1. Turn on the 5700A and allow it to warm up.

2. Execute 5700A dc zeros calibration. Do this by pressing the following sequence of softkeys:

   "Setup Menus" → "Cal" → "Zero"

3. Press [PREV MENU] twice to get out of the calibration menu.

4. Verify that the EX GRD and EX SNS indicators are off; if either is lit, press [EX SNS] and [EX GRD] as necessary.

5. Test the dc voltage function as follows:

   a. Verify that the 5700A is in standby and connect the DMM as shown in Figure 4-11.

   b. Turn on the DMM and set its function switch to dcV.

   c. Set the warmed up 5700A to 2.7V dc. Press [OPR STBY].

   d. Use the output adjustment controls to adjust the 5700A output for a reading of +2.70 on the DMM.

   e. Verify that the error shown on the control display is less than the specification for the DMM in its Operator's Manual.

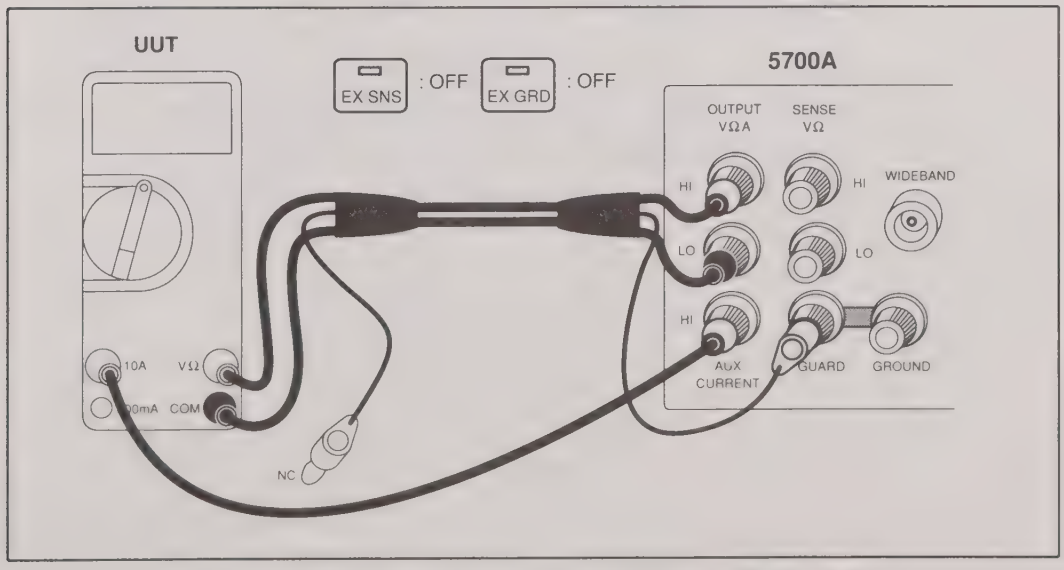


Figure 4-11. Cable Connections for Testing a Fluke 70 Series DMM

f. Check the DMM error at 27V and 270V. Hint: use [x10]. See if the errors are within specification. When [x10] causes the output to go over 22V, the 5700A goes into standby. When this happens, press [OPR STBY] to operate.

g. Check the DMM error at 1000V. See if it is within specification.

h. Press [RESET] on the 5700A, verify that the STANDY annunciator is lit, and set the DMM function switch to 300mV.

i. Check the DMM error at 300 mV. See if it is within specification.

6. Test the ac voltage function:

a. Press [RESET] on the 5700A and set the DMM function switch to acV.

b. Check the error against specifications at the following voltages and frequencies:

VOLTAGE	FREQUENCY
2.7V	100 Hz
2.7V	500 Hz
750V	100 Hz
750V	1000 Hz

7. Test the dc current function:

a. Press [RESET] on the 5700A and set the DMM function switch to dcI.

b. Set the 5700A to 1.99A but do not press [OPR STBY] yet.

c. Press the "Currnt Output" softkey until the AUX label appears.

d. Press [OPR STBY] on the 5700A.

e. Use the output adjustment controls to adjust the 5700A output for a reading of +1.99 on the DMM.

f. Verify that the error shown on the control display is within specification.

g. Set the DMM function switch to 300 mA, move the current lead to the 300 mA terminal, and check the error at 27 mA and 200 mA.

8. Test the resistance function:

   a. Press [RESET] on the 5700A and set the DMM function switch to ohms.

   b. Set the 5700A to 100Ω and press [OPR STBY].

   c. Press the "2 wire Comp" softkey to turn on two-wire lead-drop compensation.

   d. Use the output adjustment controls to adjust the 5700A output until the reading on the Control Display is the same as the reading on the DMM.

   e. Verify that the error is within specification.

   f. Repeat steps d and e for the following values, leaving two-wire compensation turned on for 1 kΩ and 10 kΩ only:

      1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ

9. Press [RESET] on the 5700A. Meter testing is complete.

CALIBRATING THE METER

4-57.

Continue with calibration if any range was out of tolerance in the previous procedure.

NOTE

The adjustment for calibrating the meter requires disassembling the meter. Refer to the diagrams and access procedures in the 70 Series Service Manual.

1. Verify that the 5700A is set to 0V dc in standby. Press [RESET] if it is not.

2. Turn on the 70 Series DMM, and set its function switch to dcV.

3. Connect a set of test leads to the DMM as shown in Figure 4-12.

4. Set the 5700A to 3V dc and press [OPR STBY].

5. Adjust R8 (located just to the left of the rotary switch on the pca) in the DMM for a display reading of +3.00V dc ±.001V.

6. Press [RESET] on the 5700A. Disconnect and turn off the meter. Calibration is complete.

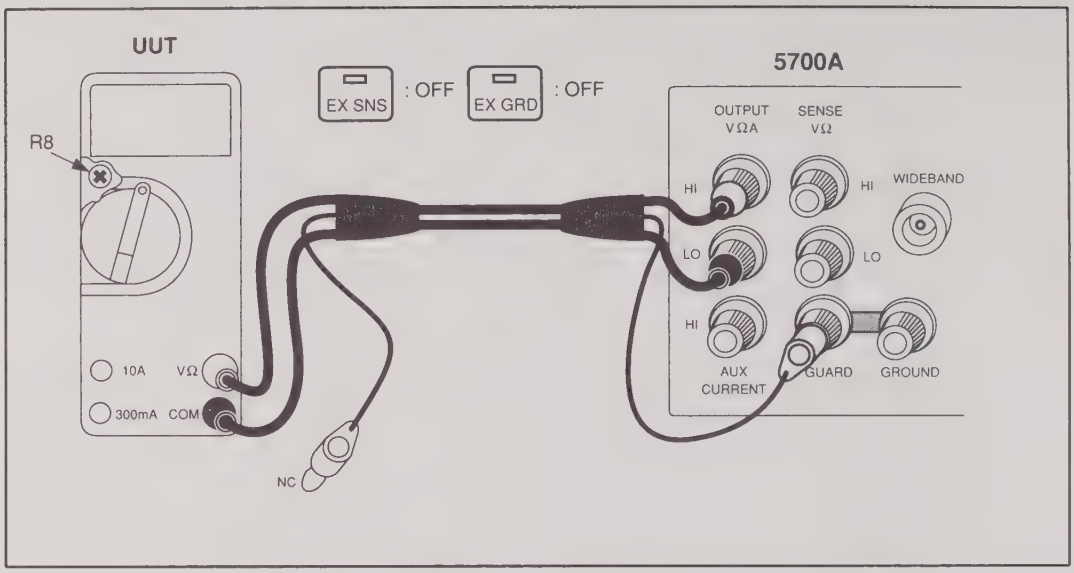


Figure 4-12. Cable Connections for Calibrating a Fluke 70 Series DMM

Calibrating an 8840A Series DMM 4-58.

This example calibrates a Model 8840A 5-½ digit DMM. Procedures used in this example are for illustrative purposes. For the authoritative and complete calibration procedures for the 8840A, refer to the 8840A Instruction Manual.

CABLES 4-59.

According to the text under "Connecting the 5700A to a UUT," the 5440A-7002 Low-Thermal Cables are recommended for:

- All dc voltage
- All resistance
- AC voltage < 10 kHz
- AC current $\leqslant 2A \leqslant 10$ kHz
- DC current $\leqslant 2A$

All the 8840A calibration outputs fall into these categories, so you should use the Low-Thermal Cables.

GUARDING 4-60.

The 8840A inputs are not grounded, so you should establish the ground point at the 5700A. To do so, set the 5700A to internal guard (EX GRD indicator off), and connect the 8840A to the 5700A as Figure 4-13 shows.

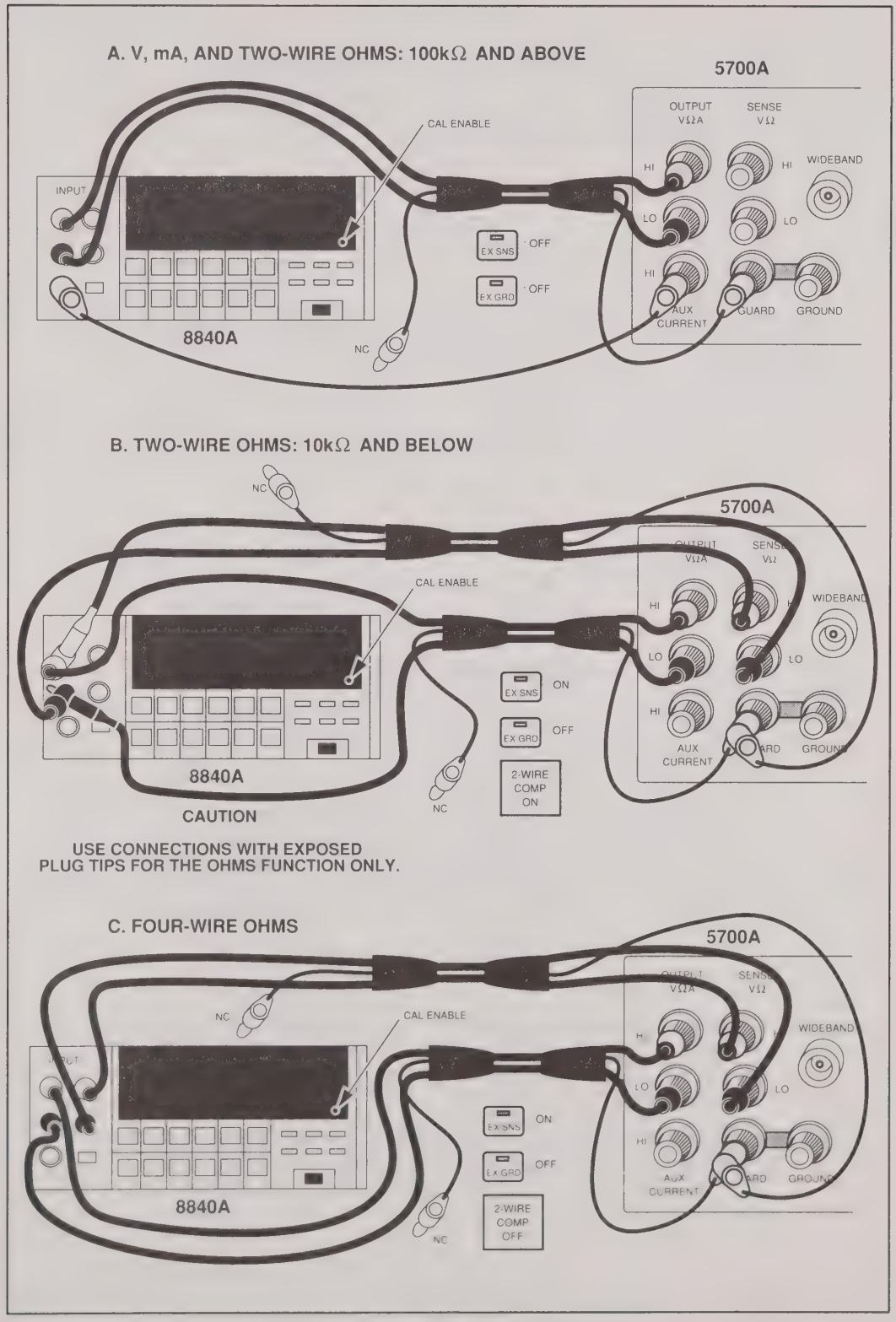


Figure 4-13. 8840A Calibration Connections

SENSING 4-61.

External sensing is required only when the voltage drop in the cables is significant. The following data determines the significance of the voltage drop in the cables:

- The input impedance of the 8840A is ≥10,000 MΩ for ranges up to 20V, and 10 MΩ for the 200V and 1000V ranges.
- The total resistance of the Model 5440A-7002 Low-Thermal Cables is 30 mΩ.

Cable voltage drop is insignificant because this is a high-impedance meter, so in this case internal sensing is appropriate.

External sensing should be used for resistance calibration in the two-wire function, however, so the 5700A two-wire compensation circuitry can sense at the meter terminals.

BASIC CALIBRATION PROCEDURE 4-62.

The basic calibration procedure consists of the following four parts. These parts must be performed in the order given.

1. Calibration setup procedure
2. A/D calibration
3. Offset and gain calibration for each function and range
4. High-frequency ac calibration (True RMS AC option only)

CALIBRATION SETUP PROCEDURE 4-63.

1. Allow the 8840A to stabilize in an environment with ambient temperature of 18 to 28° C and relative humidity less than 75%.
2. Turn the 8840A on, and allow it to warm up for at least 1 hour.
3. Turn the 5700A on, and allow it to warm up for at least 30 minutes.
4. Execute 5700A dc zeros calibration. Do this by pressing the following sequence of softkeys:

   "Setup Menus" → "Cal" → "Zero"

5. Press [PREV MENU] twice to get out of the calibration menu.
6. Enable 8840A calibration mode by pressing the 8840A CAL ENABLE switch with a small screwdriver or other suitable instrument. (The CAL ENABLE switch is located on the lower right side of the display and is normally covered by a calibration seal.)
7. Verify that the 5700A STANDBY annunciator is lit and connect the 5700A to the 8840A using Low Thermal Cables as Figure 4-13A shows.

A/D CALIBRATION 4-64.

The a/d calibration procedure calibrates the analog-to-digital converter for offset, gain, and linearity. The 8840A automatically selects the a/d calibration procedure when the CAL ENABLE switch is first pressed. The procedure must be performed in its entirety, and may not be performed in part. If the a/d calibration is discontinued prior to completion, the last complete set of a/d calibration constants will be retained unchanged.

To perform a/d calibration, proceed as follows:

1. The 8840A displays a prompt for the first reference source, 0V dc (i.e., a short).

2. Each time the 8840A prompts you for a reference source, set the 5700A to the requested value, and press the 8840A STORE button. When you press STORE, the numeric display field blanks while the 8840A performs the necessary calculations. (Do not change the 5700A output while the display is blank.) The 8840A then displays the next prompt. For reference, all prompts are shown in Table 4-4.

NOTE

The 8840A automatically checks that the reference input is near the value prompted and displays ERROR 41 if the reference input exceeds a specific tolerance. (See Advanced Features and Special Considerations in the 8840A Instruction Manual for more information.)

3. After the last input is stored, the 8840A begins taking readings in the 2V range of the VDC function. (The 8840A CAL annunciator remains on.) Verify a/d calibration using settings in Table 4-5. If you wish to repeat the a/d calibration procedure, press the 8840A A/D button.

Table 4-4. 8840A A/D Converter Calibration Prompts

STEP	8840A PROMPT
A	.0V DC (short)
B	–.03V DC
C	–1.01V DC
D	+.99V DC
E	+.51V DC
F	–.51V DC
G	–.26V DC
H	+.26V DC
I	+.135V DC
J	–.135V DC
K	–.0725V DC
L	+.0725V DC

Table 4-5. 8840A A/D Calibration Allowable Errors

STEP	5700A OUTPUT	ALLOWABLE ERROR
A	0V DC (short)	± 2 counts
B	-0.03V	± 2 counts
C	+0.03V	± 2 counts
D	-0.660V	± 3 counts
E	+0.660V	± 3 counts
F	-1.970V	± 4 counts
G	+1.970V	± 4 counts

The a/d calibration procedure is an iterative process. Each pass through the procedure uses the constants stored previously and improves them. Normally, one pass is adequate. However, if the calibration memory has been erased or replaced, or the a/d converter has undergone repair, the a/d calibration procedure must be performed twice.

Because the a/d calibration procedure is iterative, the instrument's performance can be slightly enhanced by going through the procedure more than twice. However, this is not necessary to meet the 8840A's published specifications.

OFFSET AND GAIN CALIBRATION 4-65.

The offset and gain calibration procedure calibrates the 8840A's offsets and gains by applying a high and low input for every range of each function. To save time, the 8840A uses each input for as many ranges as possible.

A function is calibrated by pressing the corresponding function button. Once a function is selected, the 8840A automatically steps through each range of that function, prompting you for the necessary 5700A outputs. (The prompts are shown in Table 4-6.) The 8840A does not automatically select another function after one function has been completely calibrated; therefore, the functions may be calibrated in any order.

To perform offset and gain calibration, proceed as follows:

1. Ensure that a/d calibration has been completed.

2. Verify the the 5700A is in standby and connected to the 8840A as shown in Figure 4-13A.

3. Select the 8840A VDC function by pressing the VDC function button. The 8840A displays the first prompt for that function.

4. Each time the 8840A prompts you for a 5700A output, apply this output and press the 8840A STORE button. When you press STORE, the numeric display field blanks while the 8840A performs the necessary calculations. (Do not change the reference source while the display is blank.) The 8840A then displays the next prompt. For reference, all prompts are shown in Table 4-6.

Table 4-6. 8840A Offset and Gain Calibration Prompts

STEP	DISPLAYED PROMPT				
	VDC	VAC[1]	2 WIRE kΩ 4 WIRE kΩ	mA DC	mA AC[1]
A	+00.0 mV DC (short)	10.0 mV AC	0.00 Ω (short)	00.0 mA DC (open)	100. mA AC
B	+190.0 mV DC	100.0 mV AC	100.0 Ω	1000. mA DC	1000 mA AC
C	+1.900 V DC	1.000 V AC	1.000 kΩ	Steps C-G not applicable for these functions.	
D	+19.00 V DC	10.00 V AC	10.00 kΩ		
E	+190.0 V DC	100.0 V AC	100.0 kΩ		
F	+1000. V DC	500. V AC	1000. kΩ		
G	Step G not applicable for these functions.		10.00 MΩ		

1. Inputs should be at 1 kHz ±10%. Performance may be enhanced for specific frequencies (see 8840A Instruction Manual for more information).

5. After the last range is calibrated, the 8840A begins taking readings in the highest range so that you may verify its calibration. (The CAL annunciator remains on.) To verify the calibration for the other ranges, press the corresponding range button. (Pressing a function button begins the offset and gain calibration procedure for that function.)

6. Repeat steps 2, 3, and 4 for the remaining functions.

   Both two-wire and four-wire ohms functions must be calibrated. (The V ac and mA ac functions require calibration only if the True RMS AC option is installed.)

   - To calibrate two-wire ohms 100 kΩ and above, use the connection shown in Figure 4-13A.
   - To calibrate two-wire ohms 10 kΩ and below, use the connection shown in Figure 4-13B and turn on 5700A two-wire compensation.
   - To calibrate four-wire ohms, use the connection shown in Figure 4-13C, turn off 5700A two-wire compensation, and press [EX SNS] so that its indicator is lit.

   For the mA ranges, use the connection in Figure 4-13A and set the 5700A current output binding post to AUX before pressing [OPR STBY].

7. When all functions have been calibrated, exit the calibration mode by pressing the 8840A CAL ENABLE switch, and attach a calibration certification sticker over the CAL ENABLE switch. (If the True RMS AC option is installed, instead of attaching the calibration sticker proceed to the High-Frequency AC Calibration procedure which follows.)

HIGH-FREQUENCY AC CALIBRATION 4-66.

The High-Frequency AC Calibration procedure calibrates the response of the 8840A ac voltage function from 20 kHz to 100 kHz. If the True RMS AC option is not installed, selecting this procedure results in an error message.

The 5700A output used in this procedure should normally be between 90 and 100 kHz. An output of 100 kHz (nominal) is recommended. For special applications, performance may be optimized at other frequencies. See "Optimizing AC Calibration at Other Frequencies" in the 8840A Instruction Manual for more information.

To perform high-frequency ac calibration, proceed as follows:

1. Ensure that offset and gain calibration has been completed for the VAC function.

2. Select the High-Frequency AC Calibration procedure by pressing the 8840A HF AC button. The 8840A displays the first prompt (100 mV AC). The "U" on the 8840A display indicates the High-Frequency AC Calibration procedure has been selected.

3. Each time the 8840A prompts you for a reference amplitude, apply this amplitude to the HI and LO INPUT terminals, and press the STORE button. When you press STORE, the numeric display field blanks while the 8840A performs the necessary calculations. (Do not change the reference source while the display is blank.) The 8840A then displays the next prompt. For reference, all prompts are shown in Table 4-7.

4. After the last range is calibrated, the 8840A begins taking readings in the highest range so that you may verify its calibration. To verify the calibration for the other ranges, push the corresponding range button. The CAL annunciator remains on.

5. The calibration procedure is now completed. Exit the calibration mode by pressing the 8840A CAL ENABLE switch, and attach a calibration certification sticker over the CAL ENABLE switch.

Table 4-7. 8840A High-Frequency AC Calibration Prompts

STEP	8840A PROMPT
A	100.0 mV AC
B	1.000 V AC
C	10.00 V AC
D	100.0 V AC
E	200.0 V AC

Performing a Wideband Flatness Test 4-67.

Wideband rms voltmeters such as the Fluke 8920 Series measure ac voltage into the RF spectrum. One type of error in wideband rms voltmeters is flatness error, or error due to uneven frequency response.

Two example procedures related to wideband flatness are given here. The first example is a procedure to test the flatness or frequency response error of a wideband voltmeter to within the uncertainty of the Wideband AC Module (Option 5700A-03) flatness specification. The second example is a technique that transfers the accuracy of the 5700A's main ac voltage output to the output of the Wideband AC Module at a low frequency, then reads the absolute error of a meter with respect to the flatness specification of the Wideband AC Module at a high frequency.

EXAMPLE 1:

1. Connect the 3-foot cable supplied with the Wideband AC Module to the WIDEBAND connector to the wideband voltmeter input through the supplied 50Ω terminator.

2. Set the 5700A wideband output to 1V at 1 kHz.

3. Adjust the wideband output with the output adjustment controls for a reading of 1.00V on the wideband voltmeter.

4. Press [NEW REF] to establish this as a new reference.

5. Press [1] [0] [M] [Hz] [ENTER] to set the frequency to 10 MHz.

6. Adjust the wideband output again with the output adjustment controls for a reading of 1.00V on the wideband meter.

7. The control display now shows the frequency response error to within the uncertainty of the Wideband AC Module flatness specification.

EXAMPLE 2:

1. Connect the main output terminals of the 5700A to the wideband voltmeter input.
2. Set the 5700A main output to 1V at 1 kHz.
3. Read the meter and record the reading. (Let us assume, for example, that the meter reads 0.999V.)
4. Disconnect the leads from the main output terminals, and connect the the 5700A WIDEBAND connector to the wideband voltmeter input through the supplied 50Ω terminator.
5. Press [W BND].
6. Adjust the 5700A wideband output with the output adjustment controls for the same reading as in step 3 (0.999V in our example). The Wideband AC Module is now sourcing an accurate 1V, referenced to the main output of the 5700A. (This transfers the accuracy specification of the main ac output to the Wideband AC Module at 1V at 1 kHz.)
7. Press [NEW REF] to establish this as a new reference.
8. Press [1] [0] [M] [Hz] [ENTER] to set the 5700A frequency to 10 MHz.
9. Adjust the 5700A wideband output with the output adjustment controls for a reading of 1.00V on the wideband meter.
10. The Control Display now shows the absolute (total) error of the wideband meter to within the uncertainty of the Wideband AC Module flatness specification.

Section 5
Remote Operation

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INTRODUCTION 5-1.

The 5700A Calibrator operates directly from the front panel controls or under remote control of an instrument controller, computer, or terminal. Remote control can be interactive, with the user controlling each step from a terminal, or under the control of a computer program running the 5700A in an automated system. This section tells you how to connect, configure, and operate the 5700A in remote mode.

The remote programmer uses a language of commands called "device-dependent commands" to duplicate the functions of the front panel controls.

An alternative language capability is included for users of the Fluke Model 5100B. It lets the 5700A emulate a 5100B in response to commands and allows substituting a 5700A into a 5100B system with no, or in some cases minor, software modifications.

USING THE IEEE-488 PORT FOR REMOTE CONTROL 5-2.

The 5700A is fully programmable for use on the IEEE Standard 488.1 interface bus (IEEE-488 bus). The interface is also designed in compliance with supplemental standard IEEE-488.2. Devices connected to the bus in a system are designated as talkers, listeners, talker/listeners, or controllers. Under the remote control of an instrument controller such as the Fluke 1722A, the 5700A operates exclusively as a talker/listener on the IEEE-488 bus.

This manual assumes you know the basics of the IEEE-488 interface bus. For an introduction to the bus, request Fluke Application Bulletin AB-36, "IEEE Standard 488-1978 Digital Interface for Programmable Instrumentation."

IEEE-488 Bus Restrictions 5-3.

The following restrictions apply to all IEEE-488 systems:

1. A maximum of 15 devices can be connected in a single IEEE-488 bus system.

2. The maximum length of IEEE-488 cable used in one IEEE-488 system is the lesser of either 20 meters or 2 meters times the number of devices in the system.

Bus Setup Procedure 5-4.

Setting up the 5700A on the IEEE-488 bus requires only a choice of address and connection to a controller. To set up the 5700A for remote operation, proceed as follows:

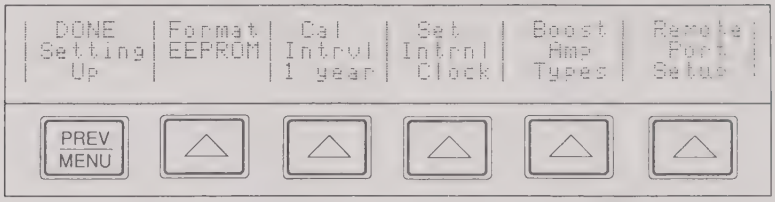
1. Turn the 5700A power off.

2. Attach the IEEE-488 cable to the rear panel IEEE-488 connector. It is recommended that you use Fluke shielded cables Y8021, Y8022, or Y8023, in lengths of 1, 2, or 4 meters, respectively, for this purpose.

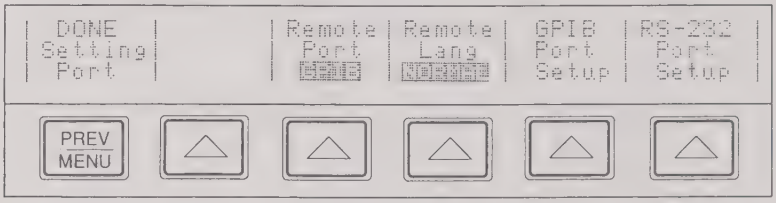
3. Turn the 5700A power on.

4. Press the "Setup Menus" softkey.

5. Press the "Instmt Setup" softkey. The Instrument Setup Menu appears:



6. Press the "Remote Port Setup" softkey. The remote port setup menu appears:



7. Press the "Remote Port" softkey so that "GPIB" (for General Purpose Interface Bus, same as IEEE-488 bus) appears.

8. Press the "Remote Lang" softkey so that "NORMAL" appears.

9. If you want to replace a Fluke Model 5100B with the 5700A in an existing remote system, a special mode allows you to do so without rewriting operating programs. To select the 5100B emulation mode, press the "Remote Lang" softkey so that "5100B" appears below the key label. (For all other remote applications, leave the "Remote Lang" setting on "NORMAL.")

   After you select 5100B emulation mode, the 5700A responds to 5100B commands and not to the commands described in this section. For more information about 5100B emulation mode, refer to "5100B Emulation Mode" later in this section.

10. If you wish to change the bus address from its factory default of 4, press the "GPIB Port Setup" softkey. The GPIB port setup menu appears:

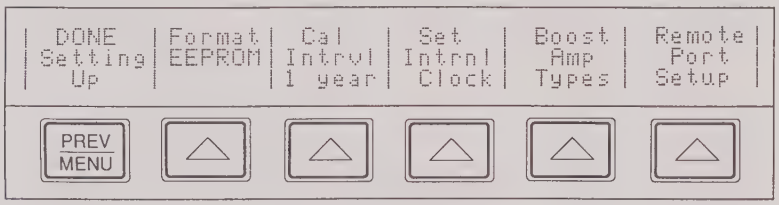
11. Change the address by pressing the "down" or "up" softkeys. Addresses are allowed in the range of 0 to 30. The address you select is saved in nonvolatile memory, and the IEEE-488 interface is changed to conform to the selection.

USING THE RS-232-C PORT FOR REMOTE CONTROL 5-5.

Skip these instructions if you are using an IEEE-488 controller such as the Fluke 1722A. These instructions are for using the 5700A's serial interface for remote control using a terminal or computer with a serial interface.

Serial Remote Control Setup Procedure 5-6.

1. Turn the 5700A power on.
2. Press the "Setup Menus" softkey.
3. Press the "Instmt Setup" softkey. The Instrument Setup Menu appears:



4. Press the "Remote Port Setup" softkey. The remote port setup menu appears:

5. Press the "Remote Port" softkey so that "RS-232" appears.
6. Press the "Remote Lang" softkey so that "NORMAL" appears.
7. Press the "RS-232 Port Setup" softkey, set the RS-232-C port to conform to the settings of the host device, and connect an interface cable as described in Section 6 under "Setting Up and Connecting the Serial Interface".

Exceptions for Serial Remote Control 5-7.

When using the RS-232-C port to remotely control the 5700A, either interactively with a terminal or under computer control, operation is the same as using an IEEE-488 controller connected to the IEEE-488 port for control, with the following exceptions:

1. Control/C performs the same function as DCL (Device Clear) or SDC (Selected Device Clear).

2. The E.O.L. (End of Line) input terminator is Carriage Return (Control/M) or Line Feed (Control/L). All output lines are terminated by the terminator programmed in a setup menu, or set using the remote command SPSET. This setting applies to all lines, including those with the *PUD command (see number 4).

3. Control/R echoes to the port a Carriage Return, a Line Feed, and any uncompleted remote command entered. This allows you to see a copy of whatever has been typed in since the last command.

4. For the *PUD (Protected User Data) Command, which stores characters for later recall, the serial remote interface does not store the following characters: Control/C, Line Feed (Control/J), Carriage Return (Control/M), Control/R, Control/S (XOFF), Control/Q (XON). These characters are processed as described above, so they cannot be a part of the *PUD command. The *PUD command terminates with Line Feed or Carriage Return, the same as all other serial remote commands.

5. There is no SRQ capability when using serial remote control. The status registers still behave as described in this section, but the 5700A serial interface does not have a way to perform the SRQ function.

6. There are three special commands available only for serial remote control. These are described in Table 5-3 following the main listing of the commands.

COMMAND SYNTAX INFORMATION 5-8.

The following syntax rules apply to all the remote commands. (A command consists of a word by itself or a word followed by one or more parameters.) The rules for parameter syntax are provided first (including proper usage of units and multipliers), followed by the rules for extra spaces, then followed by the rules for terminator usage. A description of how the 5700A processes incoming characters provides the basis for answering other possible questions about syntax. Information about syntax of response messages is also given.

Parameter Syntax Rules 5-9.

Many of the remote commands require parameters. Improper use of parameters causes command errors to occur. When a command error occurs, bit CME (5) in the Event Status Enable Register (ESE) goes to 1.

General rules for parameter usage are:

1. When a command has more than one parameter, the parameters must be separated by commas. For example: "OUT 1 V, 100 HZ."

2. Numeric parameters may have up to 255 significant figures and their exponents may range from -32000 to +32000. The useful range for 5700A programming is ± 2.2 E-308 to ± 1.8 E308.

3. Including too many parameters causes a command error.

4. Null parameters cause a command error (e.g., the adjacent commas in "CLOCK 133700, , 071787").

5. Expressions, for example "(4+2*13)", are not allowed as parameters.

Units accepted in command parameters are:

- HZ (frequency, hertz)
- MHZ (frequency, megahertz)
- V (voltage, volts)
- A (current, amperes)
- OHM (resistance, ohms)
- MOHM (resistance, megohms)
- DB (decibels)
- DBM (decibels referenced to 1 milliwatt for ac voltage amplitude)
- PCT (percent)
- PPM (parts per million)

Multipliers accepted in command parameters are:

- MA (mega, or unit x 1,000,000)
- K (kilo, or unit x 1,000)
- M (milli, or unit / 1,000; except MOHM and MHZ)
- U (micro, or unit / 1,000,000)

Some examples of allowed unit and multiplier combinations are:

- "MOHM" and "MAOHM" are both interpreted as megohms
- "MHZ" and "MAHZ" are both interpreted as megahertz
- "MV" is interpreted as millivolts
- "MAV" is interpreted as megavolts
- "MA" is interpreted as milliamperes

Extra Space Characters 5-10.

Tables 5-2 and 5-3 and the remote program examples at the end of Section 5 show commands and their parameters separated by spaces. One space after a command is required. All other spaces are optional. They are shown for clarity in the manual and may be left in or omitted as desired. Extra spaces can be inserted between parameters as desired. Extra spaces within a parameter are generally not allowed, except for between a number and its associated miltiplier or unit.

EXAMPLE:	EXPLANATION:
"OUT 188.3 MA, 442 HZ"	Equivalent to "OUT 188.3MA,442HZ"
"OUT - 110.041 V"	Invalid; no space allowed in a number
"OUT -110.041 V"	Correct form for above

Table 5-2 contains examples for commands whose parameters are not self-explanatory. Remote program examples for the Fluke 1722A Instrument Controller are provided at the end of this section.

Terminators 5-11.

To signify the end of a response sent to the controller, the 5700A sends a "terminator." The 5700A sends the ASCII character Line Feed with the EOI control line held high as the terminator for response messages. The 5700A recognizes the following as terminators when encountered in incoming data:

- ASCII LF character
- Any ASCII character sent with the EOI control line true

The terminator used by the Fluke 1722A Instrument Controller for data it sends to instruments on the IEEE-488 bus is programmable, but its default is LF with EOI.

Incoming Character Processing 5-12.

The 5700A processes all incoming data as follows (except the 8-bit data byte portion of the *PUD parameter):

1. An eighth bit (DIO8) is ignored.

2. All data is taken as 7-bit ASCII.

3. All lower-case characters are changed to upper-case.

4. ASCII characters whose decimal equivalent is less than 32 (Space) are discarded, except for characters 10 (LF) and 13 (CR) and in the *PUD command argument. *PUD allows all characters in its argument and terminates in a special way.

Response Message Syntax 5-13.

In Table 5-2, responses from the 5700A are described wherever appropriate. In order to know whether to read in an integer, a floating-point number, or character string, the first entry is "(Integer)", "(Floating)", or "(String)".

NOTE

The responses described in the command tables are correct for IEEE-488 remote control, and for serial remote control in "COMPUTER" mode. In serial remote control in "TERMINAL" mode, responses contain more descriptive text intended for an operator using a terminal interactively.

Integers for most controllers or computers are decimal numbers in the range -32768 to 32767. Response elements of this type are labeled as "integer" in the command tables. Floating-point numbers may be in exponential form, i.e. "1.15E-12". String responses may be any ASCII printing characters. A special case of string response is in the CAL_CLST?, CAL_SHIFT?, CAL_SLST?, CAL_RPT?, ECHO?, EXPLAIN?, RPT_STR?, *OPT?, and *STATE? commands. Those strings include leading and trailing quotation marks. (See their descriptions Table 5-2 for details.)

INPUT BUFFER OPERATION 5-14.

As the 5700A receives each data byte from the controller, it places the bytes in a portion of memory called the input buffer. The input buffer holds up to 128 data bytes and operates in a first in, first out fashion.

The 5700A treats the EOI IEEE-488 control line as a separate data byte and inserts it into the input buffer if it is encountered as part of a message terminator.

Input buffer operation is transparent to the program running on the controller. If the controller sends commands faster than the 5700A can process them, the input buffer fills to capacity. When the input buffer is full, the 5700A holds off the IEEE-488 bus with the NRFD (Not Ready For Data) handshake line. When the 5700A has processed a data byte from the full input buffer, it then completes the handshake, allowing the controller to send another data byte.

The 5700A clears the input buffer on power-up and on receiving the DCL (Device Clear) or SDC (Selected Device Clear) messages from the controller.

Under RS-232-C serial port remote control using Control/S (XOFF) protocol, the 5700A issues a Control/S (XOFF) when the input buffer becomes 80% full. The 5700A issues a Control/Q (XON) when it has read enough of the input buffer so that it is less than 40% full. When using RTS (Request to Send) protocol, the serial interface retracts and asserts RTS in response to same conditions as for XON/XOFF protocol.

COMMANDS 5-15.

Table 5-1 summarizes the commands by function. Table 5-2 provides protocol details of the remote commands. Table 5-3 provides protocol details of the three special commands available for serial remote control only. The commands duplicate almost all activities that can be initiated from the front panel in local operation. Separate headings for each command in the tables provide the parameters and responses (if any), and an example for cases in which the parameters or responses are not self-explanatory.

Multiple Commands 5-16.

If the controller on the IEEE-488 bus is a Fluke 1722A, commands are sent one at a time, or combined, in Fluke BASIC PRINT statements. For example, if the 5700A bus address is 3 and you want to set the 5700A to output 100 mV dc, you would use the following BASIC program statements:

```
10 REMOTE @3                ! PUT THE 5700A INTO THE REMOTE STATE
20 PRINT @3,"OUT 100 MV"    ! SELECT 0.1V DC
30 PRINT @3,"OPER"          ! ACTIVATE THE OUTPUT LIKE THE OPR/STBY KEY
```

You can achieve the same results by combining the two commands in one statement as follows:

```
10 REMOTE @3
20 PRINT @3,"OUT 100 MV ; OPER"
```

In both versions of the program, the PRINT statements transmit all necessary interface messages (ATN and MLA) automatically.

To use the 1722A to control the 5700A via its serial interface ("KB1:" on the 1722A), the equivalent program is:

```
10  SI% = 1% \ SO% = 2%
20  OPEN "KB1:" AS NEW FILE SO%
30  OPEN "KB1:" AS OLD FILE SI%
40  PRINT #SO%, "REMOTE"
50  PRINT #SO%, "OUT 100 MV ; OPER"
```

Coupled Commands 5-17.

When a compound command follows another command, there is a possibility that a fault can occur because of the action of the first command. Such commands are called coupled commands. An example of coupled commands that cause a fault is:

"OUT 1V, 1 MHZ"

followed by the compound command:

"OUT 100V ; OUT 100 HZ"

The second command causes a fault because when the 5700A encounters "OUT 100V", it is interpreted as 100V, 1 MHz, which is out of range of the instrument. If only the second compound command was sent, there would have been no fault and the 5700A would be set to 100V at 100 Hz.

Another example is:

"OUT 1V ; RANGELCK ON"

followed by:

"OUT 10V ; RANGELCK OFF."

In this case, when the 5700A interprets the first half of the second command, it causes an error since the previous command locked the range on 2.2V.

Any command that affects the state of the output is a coupled command, i.e. order-dependent. These commands include all the following: *RST, BOOST, BTYPE, CAL_CHK, CAL_REF, CAL_STORE, CAL_ZERO, CUR_POST, DIAG, EXTGUARD, EXTSENSE, FORMAT, INCR, LIMIT, MULT, NEWREF, OFFSET, OPER, OUT, PHASE, PHASELCK, PHASESFT, RANGELCK, RCOMP, REMOTE, LOCAL, LOCKOUT, SCALE, STBY, WBAND, CAL_RNG. Be careful to use appropriate sequences when using these commands.

Sequential and Overlapped Commands 5-18.

Commands executed immediately as they are encountered in the data stream are called sequential commands. Commands that begin execution, but are completed some time later are called overlapped commands, because they can be overlapped by later commands. At the end of each command description in Tables 5-2 and 5-3, the command is identified as either sequential or overlapped. Because the 5700A queues and executes overlapped commands in a multitasking way, *OPC, *OPC?, and *WAI are useful to detect completion of overlapped commands. (See the full descriptions of *OPC, *OPC?, and *WAI in Table 5-2 for more information.)

Commands Ignored When Not in Remote 5-19.

The 5700A can receive and execute most commands in either local or remote state. Commands that change the state of the instrument are prevented from executing unless the 5700A is in the remote state. At the end of each command description in Tables 5-2 and 5-3 it is noted if the command is ignored if the 5700A is not in the remote state. To put the 5700A in remote, execute the 1722A BASIC command "REMOTE", or its equivalent for other controllers. If you are using the serial port for remote control, send the "REMOTE" command (described in Table 5-3) to the 5700A. Refer to "Remote/Local State Transitions" for more information.

Commands That Require the CALIBRATION Switch To Be Set 5-20.

The following commands do not work unless the rear panel CALIBRATION switch is in the ENABLE position:

- CLOCK
- CAL_STORE
- CAL_RNG STORE
- CAL_WBFLAT STORE
- CAL_WBGAIN STORE
- *PUD
- RPT_STR

In each case, attempting to use these commands with the CALIBRATION switch in the NORMAL position logs a fault into the fault queue. (And returns an error message if in serial remote terminal mode.)

Long Term Commands 5-21.

Some remote commands take a relatively long time to execute. These are called "Long-Term Commands" and they are identified as such in Table 5-2. If a command that produces a change in instrument state (i.e., any command ignored if not in remote) is received during the execution of a long-term command, for example, CAL_CHK, the command is ignored and a device-dependent fault occurs. (Bit 3 in the Event Status Register is set to 1 if enabled, and the fault code for the fault is available to be read from the fault queue. See the "FAULT?" and "EXPLAIN?" commands for more information.)

Table 5-1. Command Summary by Function

ERROR MODE COMMANDS	
ADJOUT?	Returns the adjusted output magnitude and frequency
INCR	Increments or decrements the output
MULT	Multiplies the reference by a value and establishes a new reference
NEWREF	Establishes a new reference
OFFSET	Sets and enables or disables an offset
OFFSET?	Returns the value of the present offset
OLDREF	Sets the output to the present reference
OUT_ERR?	Returns the UUT error computed by the 5700A
REFOUT?	Returns the value of the present reference
SCALE	Activates and deactivates scaling
SCALE?	Returns scaling information
SCAL_ERR?	Returns the value of the scale error if scaling is active
INSTRUMENT CONFIGURATION COMMANDS	
BTYPE	Selects the amplifier type for voltage or current boost
BTYPE?	Returns the amplifier types set for voltage and current boost
CLOCK	Sets the clock/calendar
CLOCK?	Returns the setting of the clock/calendar
CUR_POST	Selects the active binding post for current output
CUR_POST?	Returns the active binding post for current output
EXTGUARD	Opens and closes an internal connection between GUARD and LO
EXTSENSE	Opens and closes an internal connection between SENSE and OUTPUT
FORMAT	Restores calibration constants and setups to factory defaults
LIMIT	Sets positive and negative output limits
LIMIT?	Returns the programmed positive and negative output limits
***LRN?**	Returns a list of commands that would duplicate the present state
RANGE?	Returns the present output range
RANGELCK	Locks in the present range, or selects autoranging
OUTPUT COMMANDS	
BOOST	Activates or deactivates an auxiliary amplifier
DBMOUT?	Returns the output amplitude and frequency, but in dBm if ac V
OPER	Activates the 5700A output if it is in standby
OUT	Sets the output and establishes a new reference for error mode
OUT?	Returns the output amplitude and frequency
PHASE	Sets the phase shift of the phase output signal
PHASE?	Returns the phase shift of the phase output signal
PHASELCK	Activates or deactivates phase locking to an external signal
PHASESFT	Activates or deactivates variable phase output
RCOMP	Activates or deactivates two-wire compensation circuitry
STBY	Puts the 5700A in standby
VOUT?	Returns the output amplitude in volts if the active units are dBm
WBAND	Activates or deactivates the Wideband AC Module (Option 5700A-03)
OVERALL FUNCTIONS	
***CLS**	Clear; clears status registers, any service request, and flags
ECHO?	Echos a string to the remote port
GAL	Go to Alternate Language; enters Fluke 5100B emulation mode
***OPC**	Sets bit 0 in the ESR to 1 when pending remote operations are complete
***OPC?**	Returns a "1" when all pending remote operations are complete
***PUD**	Stores a string of user-selected characters in nonvolatile memory
***PUD?**	Returns the contents of the PUD memory
RPT_STR	Loads the user report string
RPT_STR?	Returns the user report string
***RST**	Reset; sets the 5700A to its default power-up state
***WAI**	Halts remote program execution until all pending remote operations are complete
UNCERT?	Returns the calculated absolute uncertainty of the output

Table 5-1. Command Summary by Function (cont)

RS-232-C INTERFACE PARAMETER SETTING COMMANDS	
SP__EOF	Sets the End-Of-File (EOF) string
SP__EOF?	Returns the End-Of-File (EOF) string
SP__SET	Sets baud, terminal or computer mode, stall method, data bits, stop bits, parity, and End-Of-Line (EOL) string
SP__SET?	Returns baud rate, terminal or computer mode, stall method, data bits, stop bits, parity, and End-Of-Line (EOL) string
SP__TIME	Sets the timeout period
SP__TIME?	Returns the timeout period
5700A CALIBRATION, TESTING, AND DIAGNOSTICS COMMANDS	
CAL__ADJ	Does the internal portion of calibration
CAL__CHK	Starts calibration check
CAL__CLST?	Returns a group of calibration constant names and their values
CAL__CONST?	Returns the value of a particular constant
CAL__DATE?	Returns the date of the most recent calibration
CAL__DAYS?	Returns the days elapsed since last calibration recall
CAL__INTV	Sets the calibration interval
CAL__INTV?	Returns the calibration interval
CAL__PR	Prints a calibration report out the serial interface
CAL__REF	Does a calibration procedure using a 1Ω, 10 kΩ, or 10V standard
CAL__RNG	Starts a self calibration procedure of a range
CAL__RPT?	Returns a formatted calibration report
CAL__SHIFT?	Returns the shift of a range due to a calibration action
CAL__SLST?	Returns the shifts of a group of ranges
CAL__STORE	Stores new calibration constants in nonvolatile memory
CAL__TEMP	Sets the temperature for calibration
CAL__TEMP?	Returns the calibration temperature last specified
CAL__WBFLAT	Does Wideband AC Module (Option 5700A-03) flatness calibration
CAL__WBGAIN	Does Wideband AC Module (Option 5700A-03) gain calibration
CAL__ZERO	Does internal zeros calibration
DIAG	Runs self diagnostics
DIAGFLT	Sets the 5700A response to faults in remote diagnostics
DIAGFLT?	Returns the 5700A response to faults in remote diagnostics
STOP__PR	Stops printing a report
***TST?**	Performs a series of self tests and returns the results
SERIAL ONLY REMOTE COMMANDS	
LOCAL	Puts the 5700A into the local state
LOCKOUT	Puts the 5700A into the local lockout state
REMOTE	Puts the 5700A into remote state
STATUS COMMANDS	
***ESE**	Loads the Event Status Enable register
***ESE?**	Reads the Event Status Enable register
***ESR?**	Reads and clears the Event Status Register
ETIME?	Elapsed time query. Returns the number of minutes powered on.
EXPLAIN?	Decodes a fault code by returning a brief description
FAULT?	Returns the most recent fault code from the fault queue
***IDN?**	Returns 5700A identification information
ISCE	Loads the Instrument Status Change Enable register
ISCE?	Reads the Instrument Status Change Enable register
ISCR?	Reads and clears the Instrument Status Change Register
ISR?	Reads and clears the Instrument Status Register
***OPT?**	Returns a list of installed modules and attached amplifiers
***SRE**	Loads the Service Request Enable Register
***SRE?**	Reads the Service Request Enable Register
STATE?	Returns the long-term state of the 5700A
***STB?**	Returns the status byte

Table 5-2. Commands

ADJOUT?

Description: Returns the adjusted output magnitude and frequency. The adjusted output magnitude is the output after modification by the front panel knob or the INCR remote command. In all output functions but resistance, ADJOUT? behaves exactly like OUT?. In the resistance function, OUT? returns the actual 5700A output, which cannot be adjusted, and ADJOUT? returns what would be the reading on the Control Display in direct operation. The frequency is always the present output frequency. (Sequential command.)

Parameter: None

Response:
1. (Float) Output amplitude
2. (String) Units (V, DBM, A, or OHM)
3. (Float) Frequency (0 if dc or ohms)

Examples:

1.256983E+01,V,0	(12.56983V)
1.883E-01,A,4.42E+02	(188.3 mA, 442 Hz)
1.9E+06,OHM,0	(1.9 MΩ)

BOOST

Description: Activates and deactivates an accessory amplifier. (Overlapped command, ignored if not in remote.)

Parameter:

ON	(Activates the appropriate amplifier for the type of output)
OFF	(Deactivates the active amplifier)

Example: BOOST ON

Activates the appropriate amplifier if the last OUT command selected an output supported by the attached amplifier.

BTYPE

Description: Selects the accessory amplifiers for current and voltage boost. If the BOOST command is active when BTYPE is received, BTYPE does not take effect until the next time the BOOST command is received. The setting of BTYPE remains even after the power is turned off. (Sequential command, ignored if not in remote.)

Parameter: One of the following:

VB5725	(Selects the 5725A for voltage boost)
VB5205	(Selects the 5205A for voltage boost)
VB5215	(Selects the 5215A for voltage boost)
IB5725	(Selects the 5725A for current boost)
IB5220	(Selects the 5220A for current boost)

Example: BTYPE IB5725

Selects Model 5725A as the current amplifier.

BTYPE?

Description: Returns the model numbers of auxiliary amplifiers selected for voltage and current boost. (Sequential command.)

Parameter: None

Response: (String, string) <model number>, <model number>

Example: BTYPE?

Returns: "VB5215,IB5220" if Model 5215A is selected for voltage boost and Model 5220A is selected for current boost.

Table 5-2. Commands (cont)

CAL__ADJ

Description: Does the internal portion of calibration. This command should be sent after the last CAL_REF command in the sequence of calibration. (See CAL_REF for an example.) (Overlapped long-term command, ignored if not in remote.)

Parameter: None

CAL__CHK

Description: Starts calibration check. Results are available via the CAL__SLST? or CAL__SHIFT? commands. (Overlapped long-term command, ignored if not in remote.)

Parameter: None

CAL__CLST?

Description: Returns a list of names values of a particular group of calibration constants. (Sequential command.)

Parameter:
CAL (Returns active calibration constants)
CHECK (Returns calibration check constants)
PREV (Returns previous calibration constants)

Response:
(String)
"<EOL>
<total number of constants> <EOL>
<name> <value> <EOL>
<name> <value> <EOL>
(cont)
"

Example: CAL__CLST?

Could return:
"
424
D3P, 3.9817876E+02
(Continues for about 400 pairs of names and values.)
"

CAL__CONST?

Description: Returns the value of a particular calibration constant from a particular group of constants. (Sequential command.)

Parameters:
1. CAL (From active calibration constants)
   CHECK (From calibration check constants)
   PREV (From previous calibration constants)
2. Symbolic name of the calibration constant desired from Appendix D.

Table 5-2. Commands (cont)

Response: (Float) The value of the constant

Example: CAL__CONST? CHECK, KV6

Could return: 6.5000010E+00

CAL__DATE?

Description: Returns the date of the most recent calibration of the specified type. (Sequential command.)

Parameter:		
	B5725	(Last 5725A Amplifier calibration)
	CAL	(Last 5700A calibration)
	WBFLAT	(Last wideband flatness calibration)
	WBGAIN	(Last wideband gain calibration)
	ZERO	(Last dc V zero calibration)

Response: (Integer) Date as MMDDYY

CAL__DAYS?

Description: Returns the number of days elapsed since the last calibration activity of the specified type. (Sequential command.)

Parameter:		
	B5725	(Last 5725A Amplifier calibration)
	CAL	(Last 5700A calibration)
	WBFLAT	(Last wideband flatness calibration)
	WBGAIN	(Last wideband gain calibration)
	ZERO	(Last dc V zero calibration)

Response: (Integer) Number of elapsed days

CAL__INTV

Description: Sets the calibration interval for main output calibration. This value is saved in non-volatile memory and used for calculating 5700A output uncertainty. (Sequential command, ignored if not in remote.)

Parameter: 1, 90, 180, or 365; the number of days in the calibration cycle.

CAL__INTV?

Description: Returns the calibration interval for main output calibration. (Sequential command.)

Parameter: None

Response: (Integer) 1, 90, 180, or 365; the number of days in the calibration cycle.

CAL__PR

Description: Sends a calibration report printout for a particular calibration activity through the RS-232-C serial interface. This is for IEEE-488 remote control only. (See Section 6 for printout format details.) (Overlapped command.)

Parameter:		
	CAL	(Output change report for calibration)
	CHECK	(Output change report for cal check)
	RAW	(A list of all calibration constants)

CAL__REF

Description: Calibrates the internal references for the main output functions based on comparison to an externally-applied standard. To calibrate the 5700A, the controller must send a CAL__TEMP command, a sequence of CAL__REF commands (one for each external standard), followed by a CAL__ADJ command, then a CAL__STORE command. These commands must be in the same sequence as in the example. Note that the CALIBRATION switch must be set to ENABLE for the CAL__STORE command. You could use this command without a CAL__STORE just to collect performance data. (Overlapped long-term command, ignored if not in remote.)

Table 5-2. Commands (cont)

Parameter: The true value of the external standard attached to the 5700A binding posts. The value and units of the parameter tell the 5700A which calibration procedure to perform.

Example:
```
CAL_TEMP 23.5
CAL_REF 10.00013 V ; *WAI
CAL_REF -10.00013 V ; *WAI
CAL_REF 9.99987 KOHM ; *WAI
CAL_REF 1.00026 OHM ; WAI
CAL_ADJ
CAL_STORE ;
*WAI
```

CAL_RNG

Description: Starts a calibration of a range. This command causes the 5700A to source the calibration magnitude specified by the second parameter for the range specified by the first parameter. To calibrate a range, the controller must send commands in the same sequence as in the example. (Overlapped command, ignored if not in remote.)

Parameters:

1. The range identifier of the range to calibrate from Table 5-4, or the keyword NULL or STORE.

2. (Only if parameter 1 is the range mnemonic) The calibration magnitude for the 5700A to source. Must be 45 to 95% of the range specified.

3. (Optional; only if parameter 1 is the range mnemonic) The frequency of the calibrator output with optional multiplier and units.

Example:
```
CAL_TEMP 23.5
CAL_RNG DC22V, 2V ; OPER ; *WAI
INCR (enough to null the 5700A)
CAL_RNG NULL
CAL_RNG STORE
```

CAL_RPT?

Description: Returns a the text of a calibration report for a particular calibration activity. (Sequential command.) (See Section 6 for printout format details.)

Parameter:

CAL	(Output change report for calibration)
CHECK	(Output change report for cal check)
RAW	(A list of all calibration constants)

Response:
```
(String)
"<EOL>
<formatted report>
"
```

Example:
```
10    REM  THIS 1722A PROGRAM SAVES FORMATTED REPORT IN A FILE
20    CLOSE 1 \ OPEN "MF0:CALRPT" AS NEW FILE #1
30    PRINT @4,'CAL_RPT? CAL'
40    INPUTLINE @4,A$ ! THROW AWAY BEGINNING QUOTE
50    ! DO {
60      INPUTLINE @4,A$
70      PRINT #1,A$
80      IF LEFT(A$,1%) != "" GOTO 60
90    !} WHILE(NOT END OF FILE)
```

Table 5-2. Commands (cont)

CAL__SHIFT?

Description: Returns a particular set of output shifts from a particular range. (Sequential command.)

Parameters:
1. CAL (Output changes due to calibration check)
   CHECK (All output changes due to calibration check)
2. Range identifier from Table 5-4

Response:
(String)
"<EOL>
<range name>,<# points><EOL>
<mag 1>,<freq 1>,<offset 1>,<ashift 1>,<rshift 1>,<sshift 1>,<spec 1><EOL>
. . .
<mag n>,<freq n>,<offset n>,<ashift n>,<rshift n>,<sshift n>,<spec n><EOL>
"
Where:

<range name> = Range identifier from Table 5-4
<# points> = (Integer) Number of points for the range
<mag n> = (Float) Magnitude for point n in range units
<freq n> = (Float) Frequency for point n in Hz
<offset n> = (Float) Zero shift for point n in range units
<ashift n> = (Float) Absolute shift for point n in range units
<rshift n> = (Float) Relative shift for point n (ppm)
<sshift n> = (Float) % of spec shift for point n
<spec n> = 5700A specification for point n in ppm

Range units are the appropriate units for the range, e.g., for all DC V ranges, range units are V.

Example: CAL__SHIFT? CAL, DC220MV could return:

"
DC220MV,2
2.20E-1,0.00E+00,1.76E-07,1.97E-07,8.98E-01,7.10E+00,1.26E+01
-2.20E-1,0.00E+00,1.58E-07,1.38E-07,6.26E-01,4.95E+00,1.26E+01
"

CAL__SLST?

Description: Returns a group of calibration constant shifts due to a calibration activity. (Sequential command.)

Parameter: CAL (All output changes due to calibration)
CHECK (All output changes due to calibration check)

Response: (String) "<OL>
<range name>,<# points><EOL>
<mag 1>,<freq 1>,<offset 1>,<ashift 1>,<rshift 1>,<sshift 1>,<spec 1><EOL>
. . .
<mag n>,<freq n>,<offset n>,<ashift n>,<rshift n>,<sshift n>,<spec n><EOL>
"
Where:

<range name> = Range identifier from Table 5-4
<# points> = (Integer) Number of points for the range
<mag n> = (Float) Magnitude for point n in range units
<freq n> = (Float) Frequency for point n in Hz
<offset n> = (Float) Zero shift for point n in range units
<ashift n> = (Float) Absolute shift for point n in range units
<rshift n> = (Float) Relative shift for point n (ppm)
<sshift n> = (Float) % of spec shift for point n
<spec n> = 5700A specification for point n in ppm

Range units are the appropriate units for the range, e.g., for all DC V ranges, range units are V.

Table 5-2. Commands (cont)

Example: CAL__SLST? CAL could return:

"
49
DC220MV,2
2.20E-1,0.00E+00,1.76E-07,1.97E-07,8.98E-01,7.10E+00,1.26E+01
-2.20E-1,0.00E+00,1.58E-07,1.38E-07,6.26E-01,4.95E+00,1.26E+01
DC22V,2
(cont.)
"

CAL__STORE

Description: Stores all new calibration constants in nonvolatile memory. Use this command to save the results of a CAL_ADJ command after you are completely finished with calibration via remote control. The rear panel CALIBRATION switch must be in the "ENABLE" position or an execution fault results. (Sequential command, ignored if not in remote.)

Parameter: None

CAL__TEMP

Description: Sets the temperature for calibration. This should be done before sending CAL__REF, CAL__WBFLAT, CAL__WBGAIN, or CAL__CHK commands. Once set, the temperature is used for all calibration activities until it is changed. If the temperature is not set before a calibration activity, the 5700A uses a default of 23.0 °C. (Sequential command, ignored if not in remote.)

Parameter: Temperature in degrees C.

CAL__TEMP?

Description: Returns the previous ambient temperature setting used for a particular calibration procedure. (Sequential command.)

Parameter: B5725, CAL, WBFLAT, WBGAIN, or CHECK

Response: (Float) Temperature in degrees C.

CAL__WBFLAT

Description: Does Wideband AC Module (Option 5700-03) flatness calibration. There are two different calibration procedures for the wideband module; gain and flatness. Wideband gain is to be done at every 5700A calibration cycle. Wideband flatness is needed only during full verification, recommended every two years. For reference, the manual procedure for wideband flatness cal is in Section 3 of the 5700A Service Manual.

After sending a CAL__WBFLAT START command, the controller must adjust the 5700A output using the INCR command until it matches the calibration voltage, then inform the 5700A of the fact by sending a CAL__WBFLAT NULL command. A series of points to test is selected automatically by the software. After each CAL__WBFLAT NULL command, you can determine the calibration setting by sending an OUT? command. CAL__WBFLAT is an overlapped command, ignored if not in remote.

Parameter:
START (Starts flatness calibration, sources the first point)
NULL (Calculates flatness constant, sources the next point)
STORE (Stores wideband flatness constants into EEPROM)

Example:
CAL__TEMP 24.6
CAL__WBFLAT START
(Connect to external standard as in the Service Manual)
OPER
INCR (Enough to get the 5700A output correct)
CAL__WBFLAT NULL
(Repeat thepreceding two commands for each calibration point. CAL__NULL automatically sources the next calibration point. When OUT? returns 0,V,0, all points have been calibrated.)
CAL__WBFLAT STORE

Table 5-2. Commands (cont.)

CAL__WBGAIN

Description: Does Wideband AC Module (Option 5700-03) gain calibration. There are two different calibration procedures for the wideband module; gain and flatness. Wideband gain is to be done at every 5700A calibration cycle. Wideband flatness is needed only during full verification, recommended every two years. For reference, the manual procedure for wideband gain cal is in Section 7.

To calibrate wideband gain in remote, the wideband output cable must be connected to the 5700A SENSE binding posts as described in Section 7, then the controller must send commands in the same sequence as in the example. For positive gain, the center conductor is connected to SENSE HI. For negative gain, the center conductor is connected to SENSE LO.

CAL__WBGAIN is an overlapped long-term command.

Parameter:

PGAIN	(Calibrates wideband positive gain)
NGAIN	(Calibrates wideband negative gain)
STORE	(Stores wideband constants into EEPROM)

Example:

```
CAL__TEMP 23.5
CAL__WBGAIN PGAIN (Calibrates positive gain)
(Reverse the SENSE connection now)
CAL__WBGAIN NGAIN (Calibrates negative gain)
CAL__WBGAIN STORE
```

CAL__ZERO

Description: Does internal zeros calibration. This removes offsets on the 2.2V dc range. It takes about 15 seconds, and does not require setting the CALIBRATION switch. (Overlapped long-term command, ignored if not in remote.)

Parameter: None

CLOCK

Description: Sets the clock/calendar. The rear panel CALIBRATION switch must be in the "ENABLE" position or an execution fault results. (Sequential command, ignored if not in remote.)

Parameters:
1. Time in 24-hour format as HHMMSS
2. Date as MMDDYY

Examples: CLOCK 133700, 071788

Sets the clock/calendar to 1:37 p.m., July 17, 1988.

CLOCK 080000, 101088

Sets the clock/calendar to 8:00 a.m., November 10, 1988.

CLOCK?

Description: Returns the setting of the clock/calendar. The CALIBRATION switch must be set to ENABLE. (Sequential command.)

Parameter: None

Response:
1. (Integer) Time as HHMMSS.
2. (Integer) Date as MMDDYY.

Table 5-2. Commands (cont)

Example: CLOCK?

Returns: "150000,090188" if the clock/calendar is set to 3 p.m., September 1, 1988.

***CLS**

Description: (Clear status.) Clears the ESR, ISCR, the fault queue, and the RQS bit in the status byte. This command terminates pending operation complete commands (*OPC or *OPC?). (Sequential command.)

Parameter: None

CUR_POST

Description: Selects the binding posts for current output. Once set, the 5700A retains the current post setting during power-off periods. (Sequential command, ignored if not in remote.)

Parameter:		
	NORMAL	(Selects the OUTPUT HI binding post)
	AUX	(Selects the AUX CURRENT OUTPUT binding post)
	IB5725	(Selects binding posts on the 5725A)

CUR_POST?

Description: Returns the binding posts for current output. (Sequential command.)

Parameter: None

Response:		
	(String) NORMAL	(The OUTPUT HI binding post is selected)
	AUX	(The AUX CURRENT OUTPUT binding post is selected)
	IB5725	(The 5725A binding posts are selected)

DBMOUT?

Description: Same as OUT? except that if output is ac V, the returned magnitude is converted to dBm for the appropriate load (50Ω for wideband, 600Ω standard ac V). (Sequential command.)

Parameter: None

Response:
1. (Float) Output value
2. (String) Units (DBM, V, A, or OHM)
3. (Float) Frequency (0 if dc or ohms)

Examples:		
	1.256983E+01,V,0	(12.56983V)
	28.345,DBM,442	
	1.9E+06,OHM,0	(1.9 MΩ)

DIAG

Description: Runs a self-diagnostics routine. If any faults are detected, they are logged into the fault queue where they can be read by the FAULT? query. The response to faults that occur during remote-controlled diagnostics depends by the setting of the DIAGFLT command. (Overlapped long-term command, ignored if not in remote.)

Parameter:		
	ALL	(Runs all diagnostics routines)
	D5700	(Runs all 5700A diagnostics)
	DV5725	(Runs 5725A voltage diagnostics)
	DI5725	(Runs 5725A current diagnostics)
	CONT	(Continues execution of diagnostics)
	ABORT	(Terminates execution of diagnostics)

DIAGFLT

Description: Determines the response to faults that occur during remote-controlled diagnostics. In all cases the fault encountered is logged into the fault queue before the 5700A takes any action as set by this command. The settings of this command are saved in nonvolatile memory. The default is "ABORT". (Sequential command, ignored if not in remote.)

Table 5-2. Commands (cont)

Parameter: HALT (Halts and waits for DIAG CONT or DIAG ABORT)
ABORT (Terminates diagnostics)
CONT (Diagnostics continues to completion, logging any more faults as encountered)

DIAGFLT?

Description: Returns the setting of DIAGFLT. (Sequential command.)

Parameter: None

Response: (String) HALT, ABORT, or CONT

ECHO?

Description: Echos a string back to the remote interface port. Upper or lower case remains intact in ths command. (Sequential command.)

Parameter: Any string

Response: (String including delimiting quotation marks)

Example: ECHO "123abc456"

Returns: "123abc456"

***ESE**

Description: Loads a byte into the Event Status Enable Register, described under "Checking 5700A Status." (Sequential command.)

Parameter: The decimal equivalent of the binary number to load into the register.

Example: *ESE 140

Enables bits 2 (QYE), 3 (DDE), and 7 (PON), and disables all the other bits. (See "Checking 5700A Status" for details.)

***ESE?**

Description: Returns the byte from the Event Status Enable register, described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: (Integer) Decimal equivalent of the register byte.

Example: *ESE?

Returns: "140" if bits 2 (QYE), 3 (DDE), and 7 (PON) are enabled (1) and the rest of the bits are disabled (0). (See "Checking 5700A Status" for details.)

***ESR?**

Description: Returns the byte from the Event Status Register and clears the register. The ESR is described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: (Integer) Decimal equivalent of the register byte.

Example: *ESR?

Returns: "140" if bits 2 (QYE), 3 (DDE), and 7 (PON) are set (1) and the rest of the bits are reset (0). (See "Checking 5700A Status" for details.)

Table 5-2. Commands (cont)

ETIME?

Description: Elapsed time query. The response is the total number of minutes that the power switch has been on for the life of the instrument. An example of using this command would be detecting when an interval you set for cleaning the air filter has expired. (Sequential command.)

Parameter: None

Response: (Integer) Total number of minutes that the power has been on.

EXPLAIN?

Description: Explains a fault code. This command returns a string that explains the fault code furnished as the parameter. The fault code (same as the parameter) is or§ginally obtained by sending the FAULT? query. (Sequential command.)

Parameter: The fault code (an integer).

Response: (String) An explanation of the fault code.

Example: EXPLAIN? 725

Returns: "ILLEGAL LIMIT SETTING"

EXTGUARD

Description: Sets the 5700A to internal or external guard. (The same as pressing EX GRD in local operation.) The default is internal guard. (Overlapped command, ignored if not in remote.)

Parameter:

ON	(Sets the 5700A to external guard)
OFF	(Sets the 5700A to internal guard)

EXTSENSE

Description: Selects internal or external sensing. (The same as pressing EX SNS in local operation.) The default if internal sensing. (Overlapped command, ignored if not in remote.)

Parameter:

ON	(Sets the 5700A to external sensing)
OFF	(Sets the 5700A to internal sensing)

FAULT?

Description: Returns the earliest fault code contained in the 5700A fault queue. After you get the fault code, you can use the EXPLAIN? command to find out the meaning of the fault code. A table of fault codes is also included in Section 4 of this manual.

A zero value is returned if there are no faults, so to read the entire contents of the fault queue, repeat FAULT? until the response is "0". (Sequential command.)

Parameter: None

Response: (Integer) The fault code

FORMAT

Description: Use with extreme care. Restores the contents of the EEPROM (Electrically-Erasable Programmable Read Only Memory) to to factory defaults. The EEPROM holds calibration constants and setup parameters. You lose all calibration data permanently. The CALIBRATION switch must be in the ENABLE position, or an execution fault occurs. (Sequential command, ignored if not in remote.)

Parameter:

ALL	(Replaces the whole contents with defaults)
B5725	(Replaces 5725A cal constants with defaults)
CAL	(Replaces all cal constants with defaults)
RNG	(Replaces range cal constants with defaults)
SETUP	(Replaces setup parameters with defaults)

Table 5-2. Commands (cont)

GAL

Description: (Go to Alternate Language.) Selects the 5100B emulation remote mode. The new language remains selected even after the power is turned off. The inverse command in 5100B mode, to go back to normal 5700A mode, is a tilde (~). (Sequential command.)

Parameter: L5100 5100B emulation remote mode

***IDN?**

Description: Returns instrument model number and firmware version letters for the main, inguard, and if attached, the 5725A Amplifier CPU. (Sequential command.)

Parameter: None

Response: (String, string, 0, string)
A message containing four fields separated by commas, as follows:

1. Fluke
2. Calibrator model number
3. 0 (not used)
4. Firmware versions (three letters, one each for the Main CPU, the Inguard CPU, and the 5725A CPU. If no 5725A is attached, its letter is an asterisk.)

Example: FLUKE,5700A,0, ABC

INCR

Description: Increments the output amplitude and enters error mode, the same as using the output adjustment knob in local operation. (Overlapped command, ignored if not in remote.)

Parameter: Increment step size; positive for incremental step, negative for decremental step. Units (optional) specify magnitude or frequency.

Examples: INCR -.00001

Enters error mode and decrements the output by .00001.

INCR 1 Hz

Enters error mode and increments the frequency by 1 Hz.

ISCE

Description: Loads a byte into the Instrument Status Change Enable register described under "Checking 5700A Status." (Sequential command.)

Parameter: The decimal equivalent of the binary number to load into the register.

Example: ISCE 56

Enables bits 3 (BOOST), 4 (RCOMP), and 5 (RLOCK) in the Service Request Enable register.

ISCE?

Description: Returns the byte from the Instrument Status Change Enable register, described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: The decimal equivalent of the register contents byte.

Example: ISCE?

Returns: "4" if bit 3 (BOOST) is enabled (1) and the rest of the bits are disabled (0). (See "Checking 5700A Status" for details.)

Table 5-2. Commands (cont)

ISCR?

Description: Returns and clears the byte from the Instrument Status Change Register, described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: The decimal equivalent of the register contents byte.

Example: ISCR?

Returns: "8" if bit 3 (BOOST) is set (1) and the rest of the bits are reset (0). (See "Checking 5700A Status" for details.)

ISR?

Description: Returns and clears the byte from the Instrument Status Register, described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: The decimal equivalent of the register contents byte.

Example: ISR?

Returns: "16" if bit 4 (RLOCK) is set (1) and the rest of the bits are reset (0). (See "Checking 5700A Status" for details.)

LIMIT

Description: Sets the maximum permissible output magnitudes, negative and positive. Both parameters must be present, and the units must be none, volts, or amps. The units must not conflict. If no units are specified, V is assumed. (Sequential command, ignored if not in remote.)

Parameter:
1. Positive limit value with optional multiplier and optional unit.
2. Negative limit value with optional multiplier and optional unit.

Example: LIMIT 1.8A, -1.2A

Sets the limit for ac and positive dc current to 1.8A and negative dc current to -1.2A.

LIMIT?

Description: Returns the programmed output magnitude limits for voltage and current. (Sequential command.)

Parameter: None

Response: (Float, float, float, float)
1. Positive voltage limit value
2. Negative voltage limit value
3. Positive current limit value
4. Negative current limit value

Example: LIMIT?

Returns: "2.20E-2,-1.0E-2,1.8E0,-1.2E0" if the programmed voltage range is -100 to 220V, and the programmed current range is -1.2 to 1.8A.

Table 5-2. Commands (cont)

***LRN?**

Description: Learns the current setting of the 5700A. The response to this command is a string that when sent back to the 5700A at a later time recreates the the state of the following settings:

- Output value
- Operate/standby
- Guard
- Sense
- Output limits
- Whether the wideband AC Module is on
- Whether an auxiliary amplifier is on
- Range lock
- Two-wire compensation
- Phase lock
- Phase shift
- Offset
- Scale

*LRN is a sequential command.

Parameter: None

Response: (String) A string that when later sent to the 5700A recreates the settings present at the time of the *LRN? command.

Example:
```
PRINT @4, "*LRN?"
INPUTLINE @4, A$
      .
      .
(Later, to recreate the settings:)
PRINT @4, A$
```

MULT

Description: Multiplies the reference magnitude by the parameter and changes the output to the new value. The reference magnitude is the present output in direct operation, and the reference in error mode. (Overlapped command, ignored if not in remote.)

Parameter: Floating-point number to act as a multiplier

Example: If the output is 10V with error mode off and you send the command, "MULT 1.9", the output changes to 19V.

NEWREF

Description: Sets reference value to be the present 5700A output value. (The same as pressing the NEW REF key in local operation.) (Sequential command, ignored if not in remote.)

Parameter: None

OFFSET

Description: Enables and disables an offset. The offset is set to the output value in effect at the time of this command. (Sequential command, ignored if not in remote.)

Parameter: ON or OFF

Table 5-2. Commands (cont)

OFFSET?

Description: Returns the offset value if an offset is active; otherwise, returns the number 0.0. (Sequential command.)

Parameter: None

Response: 1. (Float) Offset value or 0.0 if no offset is active
2. (Float) Offset units

Example: OFFSET?

Returns: "5.05000E-03,V" if an offset of 5.05 mV is active.

OLDREF

Description: Sets the 5700A output to the previously-programmed reference value. (The same as pressing the ENTER key in local operation.) (Overlapped command, ignored if not in remote.)

Parameter: None

***OPC**

Description: Sets bit 0 (OPC for "Operation Complete") in the Event Status Register to 1 when all pending device operations are complete. (Sequential command.)

Parameter: None

Response: Sets bit 0 (OPC for "Operation Complete") in the Event Status Register to 1 when all pending device operations are complete.

Example: If you had sent an "OUT" command, you can check if the output has settled by sending "*OPC." As soon as the "OUT" command has completed (output settled), a pending *OPC command sets bit 0 (OPC for "Operation Complete") in the Event Status Register to 1. The command to read the ESR is "*ESR?."

***OPC?**

Description: Returns a 1 after all pending operations are complete. This commands causes program execution to pause until all operations are complete. (See also *WAI.) (Sequential command.)

Parameter: None

Response: (Integer) "1" after all operations are complete.

Example: If you had sent an "OUT" command, you can check if the output has settled by sending "*OPC" or "*OPC?." As soon as the "OUT" command has completed (output settled), a pending *OPC command places a "1" in the output buffer to be read by the controller.

OPER

Description: Activates the 5700A output if it is in standby. (Overlapped command, ignored if not in remote.)

Parameter: None

Table 5-2. Commands (cont)

***OPT?**

Description: Returns a list showing the analog modules installed in the 5700A, including any auxiliary amplifiers that are attached. (Sequential command.)

Parameter: None

Response: (Series of strings) A list of the names of the modules and auxiliary amplifiers, separated by commas.

Example: "5725A Attached","5215A Attached"

OUT

Description: Sets the output of the 5700A and establishes a new reference point for shifting the output to determine UUT error. If only one parameter is supplied, the 5700A makes the least amount of changes to comply with the requested output. For example, if the 5700A setting is 1V, 100 Hz and you send "OUT 2V", the 5700A setting changes to 2V, 100 Hz. (Overlapped command, ignored if not in remote.)

Parameters:
1. (Optional) Output amplitude with optional multiplier and unit. (At least one parameter must be sent.)
2. (Optional) Output frequency with optional multiplier and unit. (At least one parameter must be sent.)

Examples:

OUT -15.2 V	(-15.2V; frequency unchanged)
OUT 188.3 MA, 442 HZ	(188.3 mA, 442 Hz)
OUT 1.9 MOHM	(1.9 MΩ)
OUT 100 HZ	(Sets the frequency only)

OUT?

Description: Returns the output amplitude and frequency of the 5700A. Multipliers (e.g., K or M) are not used in the response. (Sequential command.)

Parameter: None

Response:
1. (Float) Output amplitude
2. (String) Units (V, DBM, A, or OHM)
3. (Float) Frequency (0 if dc or ohms)

Examples:

1.256983E+01,V,0	(12.56983V)
1.883E-01,A,4.42E+02	(188.3 mA, 442 Hz)
1.9E+06,OHM,0	(1.9 MΩ)

OUT_ERR?

Description: Returns the UUT error computed by the 5700A after shifting the output with the INCR command. (Sequential command.)

Parameter: None

Response:
1. (Float) UUT error magnitude
2. (String) units for the above number (PPM, PCT, or DB)

PHASE

Description: Sets the phase output signal to lead or lag the main output signal by up to 180 degrees. (Overlapped command, ignored if not in remote.)

Parameter: Phase in degrees (-359 to 359, fractions ignored)

PHASE?

Description: Returns the phase angle of the variable phase output signal with respect to the main output signal. (Sequential command.)

Parameter: None

Response: (Integer) Phase in degrees (0 to 359, 0 if the output is not ac)

Table 5-2. Commands (cont)

PHASELCK

Description: When the 5700A is supplying an ac voltage, PHASELCK activates or deactivates external phase locking. (Overlapped command, ignored if not in remote.)

Parameter: ON (Activates phase locking)
OFF (Deactivates phase locking)

PHASESFT

Description: When the 5700A is supplying an ac voltage, PHASESFT activates or deactivates the variable phase output. (Overlapped command, ignored if not in remote.)

Parameter: ON (Activates variable phase output)
OFF (Deactivates variable phase output)

***PUD**

Description: (Protected user data command.) This command allows you to store a string of bytes in nonvolatile memory. This command works only when the CALIBRATION switch is in the ENABLE position. See also the RPT__STR command. (Sequential command)

Parameter: #0 <user data> <ASCII Line Feed with EOI>
or
#<non-zero digit> <digits> <user data>

For both forms, the bytes received in the <user data> field are stored in nonvolatile memory and up to 63 bytes are allowed. The first form accepts data bytes after the #0 until the ASCII Line Feed character is received with an EOI signal.

In the second form, the non-zero digit specifies the number of characters that will follow in the <digits> field. These characters must be 0 through 9 (ASCII 48 through 57 decimal). The value of the number in the <digits> field defines the number of user data bytes that will follow in the <user data> field.

Example:

*PUD #0FLUKE<Line Feed with EOI>

or

*PUD #15FLUKE

NOTE

*The 1 indicates that there is one digit to follow (in this case,"5"), and the 5 indicates that there are five characters in the remainder of the *PUD message (in this case, "FLUKE").*

Both store the word "FLUKE" in the protected user data area.

***PUD?**

Description: Returns the contents of the *PUD (Protected User Data) memory. (Sequential command.)

Parameter: None

Response: #(non-zero digit) (digits) (user data)

The non-zero digit specifies the number of characters that will follow in the <digits> field. These characters are 0 through 9 (ASCII 48 through 57 decimal). The value of the number in the <digits> field defines the number of user data bytes that follow in the <user data> field. The maximum response is 64 characters.

Example: *PUD?

Returns: "205FLUKE" assuming that this is stored as in the example for PUD* above.

Table 5-2. Commands (cont)

RANGE?

Description: Returns the present output range. (Sequential command.)

Parameter: None

Response: (String) Symbolic name of the range from Table 5-4.

RANGELCK

Description: Locks or unlocks the present output range. The range automatically unlocks if the output function changes, for example from dc volts to dc current. (Overlapped command, ignored if not in remote.)

Parameter:
ON (Locks the range)
OFF (Unlocks the range)

RCOMP

Description: While a resistance output 19 kΩ or lower is selected, RCOMP activates or deactivates two-wire ohms compensation circuitry. (Overlapped command, ignored if not in remote.)

Parameter:
ON (Turns on the two-wire compensation circuitry)
OFF (Turns off the two-wire compensation circuitry)

REFOUT?

Description: Returns the value of the reference, which is the output value of the 5700A the last time a new reference was established with an OUT, NEW__REF, or MULT. (Sequential command.)

Parameter: None

Response:
1. (Float) Output amplitude
2. (String) Units (V, A, OHM, or DBM)
3. (String) Frequency (0 if dc)

RPT__STR

Description: Loads the user report string. The user report string can be read on the Control Display in local operation, and appears on calibration reports. The CALIBRATION switch must be set to ENABLE. (Sequential command.)

Parameter: String of up to 40 characters

RPT__STR?

Description: Returns the user report string. The user report string can be read on the Control Display in local operation, and appears on calibration reports. (Sequential command.)

Parameter: None

Response: (String) Up to 40 characters

***RST**

Description: (Reset.) Sets the 5700A to its power-up default state: 0V, 0 Hz, Standby, [BOOST] off, [W BND] off, [EX GRD] off, [EX SNS] off, phase lock off, phase shift off, range lock off, [SCALE] off, [OFFSET] off, two-wire compensation off, and entry limits set to defaults.

The following things are not affected by a *RST command:

- State of the IEEE-488 interface
- Selected bus address
- Status Register Enable setting
- Contents of nonvolatile memory

*RST is a sequential command, ignored if not in remote.

Table 5-2. Commands (cont)

SCALE

Description: Turns scaling on or off. (The same as pressing the SCALE key on the front panel.) (Sequential command, ignored if not in remote.)

Parameters: ON or OFF

SCALE?

Description: Returns the full-scale nominal and full-scale actual values set when SCALE more was turned on. If scaling is off, both responses one and two are "0.0." (Sequential command.)

Responses:
1. (Float) Nominal full-scale value
2. (Float) Actual full-scale value
3. (String) V, A, or DBM; units for the first two responses

SCAL_ERR?

Description: Returns the value of the scale error if scaling is on; otherwise, this command returns 0.0. (Sequential command.)

Parameter: None

Response:
1. (Float) Scale error
2. (String) Units for scale error

SP_EOF

Description: Sets the End-Of-File character string for the RS-232-C serial interface. The EOF setting is saved when the power is turned off. (Sequential command, ignored if not in remote.)

Parameters:
1. ASCII code (decimal) for the first character
2. ASCII code (decimal) for the second character

(A "0" for parameter 1 or 2 means that there is no character in that position.)

SP_EOF?

Description: Returns the End-Of-File character string. (Sequential command.)

Parameter: None

Response:
1. (Integer) ASCII code in decimal for the 1st character
2. (Integer) ASCII code in decimal for the 2nd character

(A "0" for response 1 or 2 means there is no character in that position.)

SP_SET

Description: Sets the serial port settings and saves them in nonvolatile memory. (Sequential command, ignored if not in remote.)

Parameters: One or more of the following, in any order:

1. Baud rate as 110, 300, 600, 1200, 2400, 4800, 9600, or 19200
2. TERM or COMP (See note below)
3. XON, RTS, or NOSTALL (Stall method)
4. DBIT7 or DBIT8 (Data bits)
5. SBIT1 or SBIT2 (Stop bits)
6. PNONE, PEVEN, PODD, or PIGNORE (Parity)
7. CR, LF, or CRLF (End-Of-Line)

Table 5-2. Commands (cont)

NOTE

The "TERM" or "COMP" parameter sets the responses in serial remote control to be appropriate for interactive terminal use or operation under program control. Specifying "TERM" sets the remote port to to expect a human operator using a terminal. Specifying "COMP" sets the remote port to expect a computer program to be controlling the 5700A. (This command has the same effect as setting Remote I/F to "TERMINAL" or "COMPUTER" in the RS-232-C Port Setup Menu.)

Defaults: 9600,TERM,XON,DBIT8,SBIT1,PNONE,CRLF

Example: 1200,COMP,XON,DBIT8,SBIT1,PEVEN,CRLF

SP_SET?

Description: Returns the serial port settings contained in nonvolatile memory. (Sequential command.)

Response:
1. (Integer) One of these baud rate values: 110, 300, 600, 1200, 2400, 4800, 9600, or 19200
2. (String) TERM or COMP (Response type)
3. (String) XON, RTS, or NOSTALL (Stall method)
4. (String) DBIT7 or DBIT8 (Data bits)
5. (String) SBIT1 or SBIT2 (Stop bits)
6. (String) PNONE, PEVEN, PODD, or PIGNORE (Parity)
7. (String) CR, LF, or CRLF (End-Of-Line)

Example: 9600,TERM,XON,DBIT8,SBIT1,PNONE,CRLF

SP_TIME

Description: Sets the timeout period for the RS-232-C serial interface. (Timeout is the time the interface waits after being stalled before aborting the communication session.) The timeout setting is saved even when the power is turned off. (Sequential command, ignored if not in remote.)

Parameter:
0 No timeout
1 to 30, Timeout period in seconds

SP_TIME?

Description: Returns the timeout period for the RS-232-C serial port. Timeout is the time the interface waits after being stalled before aborting the communication session. (Sequential command.)

Parameter: None

Response:
0, No timeout (the interface will wait forever)
1 to 30, Timeout period in seconds

***SRE**

Description: Loads a byte into the Service Request Enable register (SRE), described under "Checking 5700A Status." (Sequential command.)

Parameter: The decimal equivalent of the binary number to load into the register.

Example: *SRE 56

Enables bits 3 (IIR), 4 (MAV), and 5 (ESR) in the Service Request Enable register.

Table 5-2. Commands (cont)

***SRE?**

Description: Returns the byte from the Service Request Enable register, described under "Checking 5700A Status." (Sequential command.)

Parameter: None

Response: (Integer) The decimal equivalent of the register byte.

Example: *SRE?

Returns: "56" if bits 3 (IIR), 4 (MAV), and 5 (ESR) are enabled (1) and the rest of the bits are disabled (0). (See "Checking 5700A Status" for details.)

STATE?

Description: Returns the long-term state of the 5700A. (Sequential command.)

Parameter: None

Response: 1. (Integer) Gross state, with meaning following:

0	Operating
1	Self diagnostics
2	Self diagnostics halted by a fault
3	Calibration check
4	DC zeros calibration
5	Calibration, +dc reference
6	Calibration, -dc reference
7	Calibration, 1Ω reference
8	Calibration, 10 kΩ reference
9	Calibration, internal adjustment
10	Calibration, wideband positive gain
11	Calibration, wideband negative gain
12	Wideband flatness calibration
13	Range calibration
14	5725A voltage diagnostics
15	5725A current diagnostics
16	5725A voltage troubleshooting
17	5725A current troubleshooting
18	Analog output tripped to dormant
19	Starting up

2. (String) Substate:

If operating, self calibrating, diagnosing, or testing, returns a descriptive string of the activity underway.

***STB?**

Description: Returns the status byte. The status byte is described under "Status Information." (Sequential command.)

Parameter: None

Response: (Integer) Decimal equivalent of the status byte.

Example: *STB?

Returns: "72" if bits 3 (EAV) and 6 (MSS) are set (1) and the rest of the bits are reset (0).

STBY

Description: Puts the 5700A in standby. (Overlapped command, ignored if not in remote.)

Parameter: None

Table 5-2. Commands (cont)

STOP__PR

Description: Stops printing a report. (Sequential command, ignored if not in remote.)

Parameter: None

***TST?**

Description: Initiates a series of self-tests, then returns a "0" for pass or a "1" for fail. If any faults are detected, they are logged into the fault queue where they can be read by the FAULT? query. (Sequential command, ignored if not in remote.)

Parameter: None

Response: (Integer) 0 (for Pass) or 1 (for Fail)

UNCERT?

Description: Returns the calculated maximum uncertainty of the 5700A output according to the selected calibration interval. (The same as pressing the SPEC key in local operation.) (Sequential command.)

Parameter: None

Response:
1. (Float) Uncertainty of the 5700A output (-1.0 if no specification is available)
2. (String Units for response 1 (PPM, PCT, V, A, OHM, etc.)
3. (Integer) The specification interval in days.

VOUT?

Description: Returns the output amplitude expressed in volts if the currently selected units are dBm. (Sequential command.)

Parameter: None

Response:
1. (Float) Output amplitude
2. (String) V, A, OHM; units for response 1
3. (Float) Frequency

Example: Assuming a value of 10 dBm, 10 kHz is currently active on the main output terminals, VOUT? returns: "2.4494897E+00,V,1.0000E+04"

***WAI**

Description: (Wait-to-Continue.) This command prevents further remote commands from being executed until all previous remote commands have been executed. (See also *OPC.) (Sequential command.)

Parameter: None

Example: If you had sent an OUT command, you can cause the 5700A to wait until the output has settled before continuing on to the next command by following "OUT" with a *WAI command. This is useful because "OUT" is an overlapped command, which means the 5700A would normally go on to process other commands before completing the "OUT" command.

WBAND

Description: Activates or deactivates output from the Wideband AC Module (Option 5700A-03). This has the same action as pressing the W BND key on the front panel in local operation. (Overlapped command, ignored if not in remote.)

Parameter: ON or OFF

Table 5-3. Serial Remote Control Commands

LOCAL

Description: Enables the local state. This command duplicates the IEEE-488 GTL (Go To Local) message. (Sequential command.)

Parameter: None

LOCKOUT

Description: Enables the local lockout state. This command duplicates the IEEE-488 LLO (Local Lockout) message. (Sequential command.)

Parameter: None

REMOTE

Description: Enables the remote state. This command duplicates the IEEE-488 REN (Remote Enable) message. (Sequential command.)

Parameter: None

Table 5-4. Range Identifiers for Remote Commands

DC VOLTAGE RANGES	AC VOLTAGE RANGES	DC CURRENT RANGES	AC CURRENT RANGES	RESISTANCE RANGES	WIDEBAND RANGES
DC220MV	AC2_2MV	DC220UA	AC220UA	OHM0	WB1_1MV
DC2_2V	AC22MV	DC2_2MA	AC2_2MA	OHM1	WB3_3MV
DC11V	AC220MV	DC22MA	AC22MA	OHM1_9	WB11MV
DC22V	AC2_2V	DC220MA	AC220MA	OHM10	WB33MV
DC220V	AC22V	DC2_2A	AC2_2A	OHM19	WB110MV
DC1100V	AC220V	DC5725A	AC5725A	OHM100	WB330MV
DC5205V	AC1100V	DC5220A	AC5220A	OHM190	WB1_1V
	AC5725V			OHM1K	WB3_5V
	AC5205V			OHM19K	
	AC5215V			OHM10K	
				OHM19K	
				OHM100K	
				OHM190K	
				OHM1M	
				OHM1_9M	
				OHM10M	
				OHM19M	
				OHM100M	

REMOTE/LOCAL STATE TRANSITIONS 5-22.

You can operate the 5700A using the front panel keys as described in Section 4, or you can operate it remotely using a remote controller. In addition, the 5700A can be placed in a local lockout condition at any time by command of the controller. When combined, the local, remote, and lockout conditions yield four possible operating states:

- Local

  The 5700A responds to local and remote commands. This is also called "front panel operation." Only remote commands that do not affect the state of the 5700A are allowed to execute. (For example OUT?, which returns the value of the 5700A output setting is executable in the local state, but OUT, which sets the output to another value is not executable in the local state.)

- Local with Lockout

  Local with lockout is identical to local, except the 5700A will go into the remote with lockout state instead of the remote state when it receives a remote command. The local with lockout state is entered by executing the 1722A LOCKOUT statement when using the 1722A as an IEEE-488 controller, or by sending the LOCKOUT command in Table 5-3 when using the 1722A's serial port to control the 5700A.

- Remote

  When the Remote Enable (REN) line is asserted and the controller addresses the 5700A as a listener, it enters the remote state. These conditions are met, for example, when a 1722A executes the BASIC statement "REMOTE \ PRINT @4 'OUT 10MV'" if the 5700A's address is 4. In the remote state, Control Display changes to:

Front panel operation is restricted to use of the power switch and the "GO TO LOCAL CONTROL" softkey. Pressing this softkey or sending the GTL (Go To Local) interface message returns the 5700A to the local state. (One way to send the GTL interface message is to execute the 1722A LOCAL statement.)

- Remote with Lockout

  The remote with lockout state can be entered from remote or local with lockout, but not directly from local. Remote with lockout is similar to the remote state, but restricted: the "GO TO LOCAL CONTROL" softkey label does not appear on the Control Display. To return the 5700A to the local with lockout state, the GPIB controller sends GTL. (When you are using the 1722A as an IEEE-488 controller, you can do this manually by executing a WBYTE statement.) To return the 5700A to the local state, the GPIB controller unasserts the REN control line. (In the 1722A, the "LOCAL" BASIC statement does this.) When the 5700A is in remote with lockout, the Control Display appears as follows:

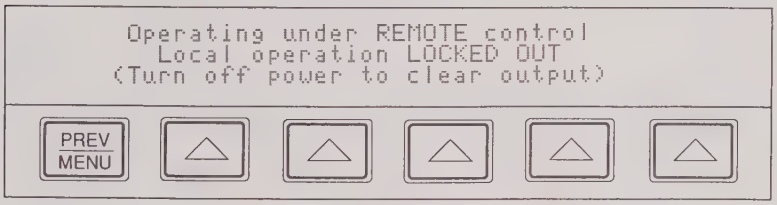


Table 5-5 summarizes the possible Remote/Local state transitions.

Table 5-5. Operating State Transitions

FROM	TO	USE	1722A GPIB COMMAND	1722A SERIAL COMMAND
Local	Remote	MAL + REN	REMOTE	REMOTE
	Local/ Lockout	LLO + REN	LOCKOUT	LOCKOUT
Remote	Local	GTL, or "GO TO LOCAL CONTROL" softkey	LOCAL	LOCAL
	Remote/ Lockout	LLO + REN	LOCKOUT	LOCKOUT
Local/ Lockout	Remote/ Lockout	MLA + REN	REMOTE, or any 5700A command	REMOTE
Remote/ Lockout	Local	REN not	LOCAL	LOCAL
	Local/ Lockout	GTL	Manually using WBYTE	None

CHECKING 5700A STATUS 5-23.

The controller has access to six 5700A status registers. The registers indicate various conditions in the 5700A. The meaning of the bits in each register are explained under separate headings for each register. Table 5-6 lists the names of the registers and their read and write remote commands.

In addition to the status registers, the Service Request control line, SRQ (available only when using an IEEE-488 controller) and a 16-element buffer called the Fault Queue provide status information.

Table 5-6. Status Register Summary

REGISTER	READ COMMAND	WRITE COMMAND	ENABLE REGISTER
Serial Poll Status Byte (STB)	*STB? (or SPL( ) for 1722A)	None	SRE
Service Request Enable Register (SRE)	*SRE?	*SRE	None
Event Status Register (ESR)	*ESR?	None	ESE
Event Status Enable Register (ESE)	*ESE?	*ESE	None
Instrument Status Register (ISR)	ISR?	None	None
Instrument Status Change Register (ISCR)	ISCR?	None	ISCE
Instrument Status Change Enable Register (ISCE)	ISCE?	ISCE	None

Serial Poll Status Byte 5-24.

The most important and frequently used register is the serial poll status byte, which the 5700A sends when it responds to a serial poll. This byte is cleared (set to 0) when the power is turned on. You cannot do a serial poll if you are using the RS-232-C port as the remote control interface. Instead, you can send the *STB? command to get the same information. Its bits are defined as follows (bits 7, 1, and 0 are always 0):

7	6	5	4	3	2	1	0
0	RQS	ESB	MAV	EAV	ISCB	0	0
	MSS						

RQS Requesting service. The RQS bit is set to 1 whenever bits ESB, MAV, EAV, or ISCB change from 0 to 1 and are enabled (1) in the SRE. When RQS is 1, the 5700A asserts the SRQ control line on the IEEE-488 interface. You can do a serial poll to read this bit to see if the 5700A is the source of an SRQ.

MSS Master summary status. Set to 1 whenever bits ESB, MAV, EAV, or ISCB are 1 and enabled (1) in the SRE. This bit can be read using the *STB? command in serial remote control in place of doing a serial poll.

ESB Is set to 1 when one or more enabled ESR bits are 1.

MAV Message available. The MAV bit is set to 1 whenever data is available in the 5700A's IEEE-488 interface output buffer.

EAV Error (fault) available. A fault has occurred and a fault code is available to be read from the fault queue by using the FAULT? query.

ISCB One or more enabled ISCR bits are 1.

SERVICE REQUEST LINE (SRQ) 5-25.

Service Request (SRQ) is an IEEE-488.1 bus control line that the 5700A asserts to notify the controller that it requires some type of service. Many instruments can be on the bus, but they all share a single SRQ line. To determine which instrument set SRQ, the Controller normally does a serial poll of each instrument. The 5700A asserts SRQ whenever the RQS bit in its Serial Poll Status Byte is 1. This bit informs the controller that the 5700A was the source of the SRQ.

The 5700A clears SRQ and RQS whenever the controller performs a serial poll of the 5700A IEEE-488 interface, sends *CLS, or whenever the MSS bit is cleared. The MSS bit is cleared only when ESB, MAV, EAV, and ISCB are 0, or they are disabled by their associated enable bits in the SRE register being set to 0.

SERVICE REQUEST ENABLE REGISTER 5-26.

The Service Request Enable Register (SRE) enables or masks the bits of the Serial Poll Status Byte. The SRE is cleared at power up. Refer to "Serial Poll Status Byte" for the bit functions.

HOW TO LOAD THE SRE 5-27.

By resetting (to 0) the bits in the SRE, you can mask (disable) associated bits in the serial poll status byte. Bits set to 1 enable the associated bit in the serial poll status byte. The following sample program enables the ESB bit.

```
10  ! THIS PROGRAM RESETS BIT 5 (CME) IN THE ESE
20  PRINT @4,"*ESE 33"                    ! INITIAL ESE (-- EXE + OPC
30  GOSUB 80                              ! GET AND PRINT INITIAL ESE
40  IF (A% AND 32%) THEN A% = A% - 32%    ! CLEAR EXE (BIT 5)
50  PRINT @4,  "*ESE ";A%                 ! LOAD THE ESE WITH THE NEW VALUE
60  GOSUB 80                              ! GET AND PRINT NEW ESE
70  END
80  PRINT @4,  "*ESE?"                    ! ASK FOR THE ESE CONTENTS
90  INPUT @4,  A%                         ! RETRIEVE THE REGISTER CONTENTS
100 PRINT "ESE = ";A%
110 RETURN
```

Event Status Register 5-28.

The Event Status Register is a two-byte register in which the higher eight bits are always 0, and the lower eight bits except bits 6 and 1 represent various conditions of the 5700A. The ESR is cleared (set to 0) when the power is turned on, and every time it is read.

A mask register called the Event Status Enable register (ESE) allows the controller to enable or mask (disable) each bit in the ESR. When a bit in the ESE is 1, the corresponding bit in the ESR is enabled. When any enabled bit in the ESR is 1, the ESB bit in the Serial Poll Status Byte also goes to 1. The ESR bit stays 1 until the controller reads the ESR or does a device clear, a selected device clear, or sends the reset or *CLS command to the 5700A. The ESE has a factory default setting of 0. If changed, it retains its setting in nonvolatile memory until changed again.

BIT ASSIGNMENTS FOR THE ESR AND ESE 5-29.

15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

7	6	5	4	3	2	1	0
PON	0	CME	EXE	DDE	QYE	0	OPC

PON Power on. This bit is set to 1 if the power supply has been turned off and on since the last time the ESR was read.

CME Command error (fault). The 5700A's IEEE-488 interface encountered an incorrectly formed command. (The command FAULT? fetches the earliest fault code in the fault queue, which contains fault codes for the first 15 faults that have occurred.)

EXE Execution error (fault). A fault occurred while the 5700A tried to execute the last command. This could be caused, for example, by a parameter being out of range. (The command FAULT? fetches the earliest fault in the fault queue, which contains fault codes for the first 15 faults that have occurred.)

DDE Device-dependent error (fault). A fault related to a device-dependent command has occurred. An example would be attempting to execute "OUT 1000000V", which is outside the range of the 5700A. (The command FAULT? fetches the earliest fault in the fault queue, which contains fault codes for the first 15 faults that have occurred.)

QYE Query error (fault). The 5700A was addressed to talk when no response data was available or appropriate, or when the controller failed to retrieve data on the output queue.

OPC Operation complete. All commands previous to reception of a *OPC command have been executed, and the interface is ready to accept another message.

HOW TO READ THE ESR AND ESE 5-30.

To read the contents of the ESR, send the remote command, "*ESR?." The ESR is cleared (set to 0) every time it is read. To read the contents of the ESE, send the remote command, "*ESE?." The ESE is not cleared when it is read. When you read either register, the 5700A responds by sending a decimal number that represents bits 0 through 15. The following sample program retrieves the contents of both registers:

```
10  ! THIS PROGRAM READS THE ESR AND THE ESE REGISTERS
20  PRINT @4, "*ESR?"           ! ASK FOR THE ESR CONTENTS
30  INPUT @4, A                 ! RETRIEVE THE REGISTER CONTENTS
40  PRINT @4, "*ESE?"           ! ASK FOR THE ESE CONTENTS
50  INPUT @4, B                 ! RETRIEVE THE REGISTER CONTENTS
60  PRINT "ESR = ";A            ! DISPLAY THE ESR REGISTER CONTENTS VALUE
70  PRINT "ESE = ";B            ! DISPLAY THE ESE REGISTER CONTENTS VALUE
80  END
```

Convert the contents of variables A and B into binary, and you can read the status of the registers. For example if A is "32", its binary equivalent is: 00000000 00100000. Therefore, bit 5 (CME) in the ESR is set (1) and the rest of the bits are reset (0). This tells you that the 5700A has encountered a command fault. (It tried to execute an incorrectly formed command.)

HOW TO LOAD THE ESE 5-31.

By resetting the bits in the ESE, you can mask (disable) the associated bits in the ESR. For example, to prevent the occurrence of a command fault from causing bit 5 (ESB) in the serial poll status byte to go to 1, you can reset (to 0) bit 5 in the ESE register. The following sample program accomplishes this by checking the status of the CME bit, then toggling it if it is 1.

```
10  ! THIS PROGRAM RESETS BIT 5 (CME) IN THE ESE
20  PRINT @4,"*ESE 33"                  ! INITIAL ESE (-- EXE + OPC
30  GOSUB 80                            ! GET AND PRINT INITIAL ESE
40  IF (A% AND 32%) THEN A% = A% - 32%  ! CLEAR EXE (BIT 5)
50  PRINT @4, "*ESE ";A%                ! LOAD THE ESE WITH THE NEW VALUE
60  GOSUB 80                            ! GET AND PRINT NEW ESE
70  END
80  PRINT @4, "*ESE?"                   ! ASK FOR THE ESE CONTENTS
90  INPUT @4, A%                        ! RETRIEVE THE REGISTER CONTENTS
100 PRINT "ESE = ";A%
110 RETURN
```

Instrument Status Register 5-32.

The Instrument Status Register (ISR) gives the controller access to the state of the 5700A, including some of the information presented to the operator on the Control Display and the display annunciators during local operation.

Instrument Status Change Register 5-33.

The Instrument Status Change Register (ISCR) indicates which ISR bits have changed status (from 0 to 1 or from 1 to 0) since the ISCR was last read. The ISCR is cleared (set to 0) when the 5700A is turned on, and every time it is read.

Instrument Status Change Enable Register 5-34.

The Instrument Status Change Enable Register (ISCE) is a mask register for the ISCR. If a bit in the ISCE is enabled (set to 1) and the corresponding bit in the ISCR goes to 1, the ISCB bit in the Status Byte is set to 1. If all bits in the ISCE are disabled (set to 0), the ISCB bit in the Status Byte never goes to 1. The ISCE is cleared when the power is turned on.

BIT ASSIGNMENTS FOR THE ISR, ISCR, AND ISCE 5-35.

The bits of the ISR, ISCR, and ISCE are assigned as follows:

15	14	13	12	11	10	9	8
0	0	RPTBUSY	SETTLED	REMOTE	WBND	SCALE	OFFSET

7	6	5	4	3	2	1	0
PLOCK	PSHFT	RLOCK	RCOMP	BOOST	EXSENS	EXGARD	OPER

RPTBUSY When 1, A calibration report is being printed to the serial port.

SETTLED When 1, the output has stabilized to within specification.

REMOTE When 1, The 5700A is under remote control.

WBND When 1, wideband is active.

SCALE When 1, scaling is active.

OFFSET When 1, an offset is active.

PLOCK When 1, the 5700A output is phase locked to an external source.

PSHFT When 1, variable phase output is active.

RLOCK When 1, the 5700A output range is locked.

RCOMP When 1, two-wire compensation is active when in resistance mode.

BOOST When 1, an auxiliary amplifier is active.

EXSENS When 1, external sensing is selected.

EXGARD When 1, external voltage guard is selected.

OPER When 1, the 5700A is operating. When 0, it is in standby.

HOW TO READ THE ISR, ISCR, or ISCE 5-36.

To read the contents of the ISR, send the remote command, "ISR?." To read the contents of the ISCR, send the remote command, "ISCR?." To read the contents of the ISCE, send the remote command, "ISCE?." The 5700A responds by sending a decimal number that represents bits 0 through 15. Every time you read the ISCR, its contents are zeroed. The following sample program reads all three registers:

```
10  ! THIS PROGRAM READS THE ISR, ISCR, AND ISCE REGISTERS
20  ! NOTE THAT THE ICSR? COMMAND ALSO CLEARS THE ISCR CONTENTS
30  PRINT @4, "ISR?"          ! ASK THE ISR CONTENTS
40  INPUT @4,A%               ! RETRIEVE THE REGISTER CONTENTS FROM THE 5700A
50  PRINT @4, "ISCR?"         ! ASK FOR AND CLEAR THE ISCR CONTENTS
60  INPUT @4, B%              ! RETRIEVE THE REGISTER CONTENTS FROM THE 5700A
70  PRINT @4, "ISCE?"         ! ASK FOR THE ISCE CONTENTS
80  INPUT @4, C%              ! RETRIEVE THE REGISTER CONTENTS FROM THE 5700A
90  PRINT "ISR =  ";A%        ! DISPLAY THE ISR
100 PRINT "ISCR = ";B%        ! DISPLAY THE ISCR
110 PRINT "ISCE = ";C%        ! DISPLAY THE ISCE
120 END
```

Convert the returned variables into binary, and you can read the status of the instrument. For example if register contains "4", its binary equivalent is: 00000000 00000100. Therefore, bit 3 (EXSNS) is set (1) and the rest of the bits are reset (0).

HOW TO LOAD THE ISCE 5-37.

By resetting the bits in the ISCE, you can mask (disable) the associated bits in the ISCR. For example, to cause an SRQ interrupt when an attached 5725A Amplifier turns on, bit 3 (BOOST) in the ISCE register must be 1. (The ISCB bit must also be enabled in the SRE.) The following sample program loads a decimal 8 into the ISCE, which sets bit 3 and resets the other bits:

```
10  ! THIS PROGRAM LOADS 00000000 00001000 BINARY INTO THE ISCE
20  PRINT @4, "ISCE 8"        ! LOAD DECIMAL 8 INTO THE ISCE
30  PRINT @4, "ISCE?"         ! READ BACK THE VALUE
40  INPUT @4, A%              ! "
50  PRINT "ISCE = ";A%        ! PRINT IT, IT SHOULD BE 8
60  END
```

Fault Queue 5-38.

When a command fault, execution fault, or device-dependent fault occurs, its fault code is placed in the fault queue where it can be read by the FAULT? command. All fault codes are defined in Appendix A of this manual. Another way to decode a fault code is to send the command, EXPLAIN?, which returns a description of a fault code. Reading the first fault with the FAULT? command removes that fault from the queue. A response of "0" means the fault queue is empty.

The fault queue contains up to 16 entries. If many faults occur, only the first 15 faults are kept in the queue. A 16th entry in the queue is always a "fault queue overflow" fault, and all later faults are discarded until the queue is at least partially read. The first faults are kept, because if many faults occur before the user can acknowledge and read them, the earliest faults are the most likely to point to the problem. The later faults are usually repetitions or consequences of the original problem.

IEEE-488 INTERFACE CONFIGURATION 5-39.

The 5700A IEEE-488 interface supports the IEEE-488 interface function subsets listed in Table 5-7.

Table 5-7. IEEE-488 Interface Function Subsets Supported

INTERFACE FUNCTION	DESCRIPTION
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T6	Basic talker, serial poll, no talk-only mode, Unaddress if MLA
TE0	No extended talker capability
L4	Basic listener operation, no listen-only mode, Unaddress if MTA
LE0	No extended listener capabilities
SR1	Full service request capability, with bit-maskable SRQ
RL1	Full remote/local capability, including local lockout
PP0	No parallel poll capability
DC1	Device clear capability
DT0	No device trigger capability
C0	No bus control capability

BUS COMMUNICATION OVERVIEW 5-40.

Communication between the controller and the 5700A takes place using commands established by IEEE-488 standards and commands specifically related to the 5700A. The commands in Tables 5-1, 5-2, and 5-3 are all the remote commands, both common and device-dependent. Definitions of the different types of messages used on the IEEE-488 bus follow.

- Device-Dependent Commands

  Device-Dependent commands are messages used to transfer information directly between the 5700A and the IEEE-488 controller. Some commands cause an action to take place in the 5700A. Others, called queries in the IEEE standards, ask for information, and always generate a response message from the instrument. While message format is governed by IEEE-488 standards, messages themselves can be unique to the 5700A. For example, device-dependent commands are used to set the output mode and amplitude, and to switch from standby to operate.

- Common Commands

  IEEE standard 488.2 defines common commands, which are used for functions common to most bus devices. Examples include the command for resetting a device (*RST) and the query for device identification (*IDN?). Common commands and queries can be identified easily because they all begin with an asterisk (*).

- Interface Messages

  IEEE standards define interface messages, which manage the interface system. Some of the interface messages have their own control lines, and others are sent over the data lines by first asserting the control line ATN (Attention). An important thing to note about interface messages is that unlike device-dependent and common commands, interface messages are not sent literally (in a direct way). For example, when you send a device-dependent query to the 5700A, the controller automatically sends the interface message MTA (My Talk Address).

Definition: Queries and Commands 5-41.

Messages directed to the 5700A fall naturally into two categories: commands and queries. Commands instruct the 5700A to do something or to set a value; no response is expected. Queries generally ask only for information from the 5700A; a response is always expected. Some queries also require the 5700A to take action. For example, the *TST? query has the 5700A do a self test, then send the result to the controller. A query always ends with a question mark. A command never ends with a question mark. Tables 5-2 and 5-3 do not separate commands and queries; they are all called commands and are presented together in one alphabetical list.

All query responses are generated instantly on receipt of the query. In other words, queries generate their output when the 5700A executes the query rather than when the controller attempts to read the response. The 5700A simply generates the requested message and places it in an area of memory called the output buffer. When the controller addresses the 5700A as a talker, the contents of the output buffer are transmitted to the controller.

Some messages have both query and command forms (e.g., *PUD and *PUD?). In such cases, the command generally sets the value of a parameter and the query generally returns the most recent value of the parameter. Some messages are queries only (e.g., *IDN?). Some messages are commands only (e.g., *RST).

Functional Elements of Commands 5-42.

Table 5-8 lists the functional elements of commands described by the IEEE-488.2 standard that are used by the 5700A. This table is for those who have a copy of the standard and want to use it to pursue additional information. The standard provides full definitions and syntax diagrams for each element.

Table 5-8. Functional Elements of Commands

ELEMENT	FUNCTION
PROGRAM MESSAGE	A sequence of zero or more PROGRAM MESSAGE UNIT elements separated by PROGRAM MESSAGE UNIT SEPARATOR elements.
PROGRAM MESSAGE UNIT	A single command, programming data, or query received by the device.
COMMAND MESSAGE UNIT	A single command or programming data received by the device.
QUERY MESSAGE UNIT	A single query sent from the controller to the device.
PROGRAM DATA	Any of the six program data types.
PROGRAM MESSAGE UNIT SEPARATOR	Separates PROGRAM MESSAGE UNIT elements from one another in a PROGRAM MESSAGE.
PROGRAM HEADER SEPARATOR	Separates the header from any associated PROGRAM DATA.
PROGRAM DATA SEPARATOR	Separates sequential PROGRAM DATA elements that are related to the same header.
PROGRAM MESSAGE TERMINATOR	Terminates a PROGRAM MESSAGE.
COMMAND PROGRAM HEADER	Specifies a function or operation. Used with any associated PROGRAM DATA elements.
QUERY PROGRAM HEADER	Similar to a COMMAND PROGRAM HEADER except a query indicator (?) shows that a response is expected from the device.
CHARACTER PROGRAM DATA	A data type suitable for sending short mnemonic data, generally used where a numeric data type is not suitable.
DECIMAL NUMERIC PROGRAM DATA	A data type suitable for sending decimal integers of decimal fractions with or without exponents.
NON-DECIMAL NUMERIC PROGRAM DATA	A data type suitable for sending integer numeric representations in base 16, 8, or 2.
SUFFIX PROGRAM DATA	An optional field following DECIMAL NUMERIC PROGRAM DATA used to indicate associated multipliers and units.
STRING PROGRAM DATA	A data type suitable for sending 7-bit ASCII character strings where the content needs to be "hidden" (by delimiters).
ARBITRARY BLOCK PROGRAM DATA	A data type suitable for sending blocks of arbitrary 8-bit information. Blocks are limited in size to 1024 bytes.

Interface Messages 5-43.

Interface messages manage traffic on the bus. Device addressing and clearing, data handshaking, and commands to place status bytes on the bus are all directed by interface messages. Some of the interface messages occur as state transitions of dedicated control lines. The rest of the interface messages are sent over the data lines with the ATN signal true. (All device-dependent and common commands are sent over the data lines with the ATN signal false.)

IEEE-488 standards define interface messages. Table 5-9 lists the interface messages that the 5700A accepts. Table 5-9 also shows the BASIC statement you execute on the 1722A Controller to generate the interface message. Table 5-10 lists the interface messages that the 5700A sends. The mnemonics listed in the tables are not sent in BASIC PRINT statements as commands are; in this way they are different from device-dependent and common commands.

Interface messages are handled automatically in most cases. For example, handshake messages DAV, DAC, and RFD automatically occur under the direction of an instrument's interface itself as each byte is sent over the bus.

Table 5-9. Interface Messages that the 5700A Accepts

MNEMONIC	NAME	FUNCTION	RELATED 1722A COMMAND
ATN	Attention	A control line that, when asserted, notifies all instruments on the bus that the next data bytes are an interface message. When ATN is low, the next data bytes are interpreted as device-dependent or common commands addressed to a specific instrument.	(None)
DAC	Data Accepted	Sets the handshake signal line NDAC low.	(None)
DAV	Data Valid	Asserts the handshake signal line DAV.	(None)
DCL	Device Clear	Clears the input/output buffers.	CLEAR
END	End	A message that occurs when the Controller asserts the EOI signal line before sending a byte.	(None)
GTL	Go To Local	Transfers control of the 5700A from one of the remote states to one of the local states. (See Table 5-5.)	LOCAL
LLO	Local Lockout	Transfers remote/local control of the 5700A. (See Table 5-5.)	LOCKOUT
IFC	Interface Clear	A control line that sets the interface to a quiescent state.	INIT

Table 5-9. Interface Messages that the 5700A Accepts (cont)

MNEMONIC	NAME	FUNCTION	RELATED 1722A COMMAND
MLA	My Listen Address	Addresses a specific device on the bus as a listener. The controller sends MLA automatically whenever it directs a device-dependent or common command to a specific instrument.	(None)
MTA	My Talk Address	Addresses a specific device on the bus as a talker. The controller sends MTA automatically whenever it directs a device-dependent or common query to a specific instrument.	(None)
REN	Remote Enable	Transfers remote/local control of the 5700A. (See Table 5-5.)	REMOTE
RFD	Ready for Data	Sets the handshake signal line NRFD low.	(None)
SDC	Selected Device Clear	Does the same thing as DCL, but only if the 5700A is currently addressed as a listener.	CLEAR @
SPD	Serial Poll Disable	Cancels the effect of a Serial Poll Enable.	(Part of SPL)
SPE	Serial Poll Enable	After the 5700A receives this message, it sends the Status Byte the next time it is addressed as a listener, no matter what the command is.	(Part of SPL)
UNL	Unlisten	"Unaddresses" a specific device on the bus as a listener. The controller sends UNL automatically after the device has successfully received a device-dependent or common command.	(None)
UNT	Untalk	"Unaddresses" a specific device on the bus as a listener. The controller sends UNT automatically after it receives the response from a device-dependent or common query.	(None)

Table 5-10. Interface Messages that the 5700A Sends

MNEMONIC	NAME	FUNCTION
END	End	A message that occurs when the 5700A asserts the EOI control line. The 5700A asserts EOI while it transmits the ASCII character LF for its termination sequence or terminator.
DAC	Data Accepted	Sets the handshake signal line NDAC low.
DAV	Data Valid	Asserts the handshake signal line DAV.
RFD	Ready for Data	Sets the handshake signal line NRFD low.
SRQ	Service Request	A control line that any device on the bus can assert to indicate that it requires attentino Refer to "Checking 5700A Status" for details.
STB	Status Byte	The Status Byte is what the 5700A sends when it responds to a serial poll (interface message SPE).

FLUKE 5100B EMULATION MODE 5-44.

You have the choice of normal IEEE-488 remote mode or emulation of the Fluke 5100B 5700A in functions and response to system controller software. The 5100B emulation mode lets you replace a 5100B in most existing systems with a 5700A, only minor software changes. 5100B procedures can then run unmodified.

NOTE

If you are using Fluke 7411B Calibration Software, an upgrade that contains a 5700A driver is available.

There are some operational differences because of the difference in features between the 5100B and the 5700A. For example, the 5100B has a different display configuration. Operating in 5100B emulation mode, the 5700A duplicates a 5100B in response to commands for output types and amplitudes, but the 5700A does not duplicate the displays shown on a 5100B during remote operation.

The only commands to which the 5700A cannot respond because of hardware differences are the tape storage commands, described in Section 2 of the 5101B Operator Manual under "Storage Commands."

There is some difference in the operation of the ohms function between the 5100B and the 5700A. The 5100B generates nominal ohms values, that is, if you request 100Ω, the 5100B sources 100Ω as closely as it can. In the 5700A, if you request 100Ω, the 5700A sources a characterized value of close to but not exactly 100Ω, and displays the resistor's characterized value on the Output Display. The following remote programs are provided to show the difference in programming required to convert a 5100B resistance program to run on a 5700A in 5100B emulation mode. If you do not do these modifications, the 5700A will still operate in 5100B emulation, but the resistance accuracy is only the 5700A's tolerance to nominal, which is less accurate than a 5100B.

5100B Emulation VS Original 5100B Ohms Remote Program Example 5-45.

The shaded areas in these programs show where to modify a 5100B resistance program for use by a 5700A in 5100B emulation mode.

```
5   REM  ORIGINAL 5100B PROGRAM
10  REM  THIS PROGRAM SETS THE 5100B TO 10 KΩ, READS THE VALUE OF A
20  REM  FLUKE 8505A DMM AND CALCULATES THE ERROR.
30  RF = 10000.0
40  INIT PORT 0                          ! CLEAR THE INTERFACE (SENDS DCL)
50  CLEAR PORT 0                         ! SET THE 5700A TO ITS POWER-UP STATE
60  PRINT @1,"ZTO"                       ! SET 8505 TO OHMS EXT TRIGGER
70  PRINT @4, RF;"Z,N"                   ! SET THE 5100B TO 10KΩ, OPERATE
80  WAIT 2000                            ! WAIT FOR OUTPUT TO SETTLE
90  PRINT @1, "?" \ INPUT @1,R           ! TRIGGER AND READ THE 8505A
100 ER = ABS(RF-R)/RF * 1E6              ! COMPUTE ERROR IN PPM
110 PRINT "EXPECTED ";RF                 ! PRINT RESULTS
120 PRINT "MEASURED ";R                  ! "
130 PRINT "ERROR    ";ER;"PPM"           ! "
```

```
5   REM  PROGRAM FOR A 5700A EMULATING A 5100B
10  REM  THIS PROGRAM SETS THE 5100B TO 10 KΩ, READS THE VALUE OF A
20  REM  FLUKE 8505A DMM AND CALCULATES THE ERROR.
30  RF = 10000.0
40  INIT PORT 0                          ! CLEAR THE INTERFACE (SENDS DCL)
50  CLEAR PORT 0                         ! SET THE 5700A TO ITS POWER-UP STATE
60  PRINT @1,"ZTO"                       ! SET 8505 TO OHMS EXT TRIGGER
70  PRINT @4, RF;"Z,N"                   ! SET THE 5100B TO 10KΩ, OPERATE
80  PRINT @4,"Y1GZ?"                     ! GET ACTUAL OHMS VALUE
90  INPUT @4,RA                          ! "
100 WAIT 2000                            ! WAIT FOR OUTPUT TO SETTLE
110 PRINT @1, "?" \ INPUT @1,R           ! TRIGGER AND READ THE 8505A
120 ER = ABS(RA-R)/RA * 1E6              ! COMPUTE ERROR IN PPM
130 PRINT "EXPECTED ";RF                 ! PRINT RESULTS
140 PRINT "ACTUAL   ";RA                 ! "
150 PRINT "MEASURED ";R                  ! "
160 PRINT "ERROR    ";ER;"PPM"           ! "
```

Entering 5100B Emulation Mode 5-46.

To activate 5100B emulation mode, either send the command "GAL L5100B", or set the remote language to "5100B" instead of "NORMAL" in the setup menus (as described in the beginning of this section.)

Once you change the setting of the remote language to "5100B", the setting is stored in nonvolatile memory. It becomes the new power-up default until changed back in the setup menu to NORMAL".

In 1722A BASIC using the IEEE-488 port for control, the statement is:

```
10  PRINT @4, "GAL L5100B"
```

After the 5700A receives this command, you can run a remote program written for the 5100B, and the 5700A will respond like a 5100B.

Exiting 5100B Emulation Mode 5-47.

When the 5700A is in 5100B emulation mode, you can toggle back to the normal 5700A IEEE-488 remote mode by sending the command:

```
"~"          (In 1722A BASIC:  10  PRINT @4, "~")
```

The tilde symbol is the complementary command in the 5100B emulation mode to the "GAL" (Go to Alternate Language) Command in the normal 5700A remote mode.

THE IEEE-488 CONNECTOR 5-48.

The IEEE-488 connector on the rear panel mates with an IEEE-488 Standard cable. The pin assignments of the rear-panel IEEE-488 connector are shown in Figure 5-1.

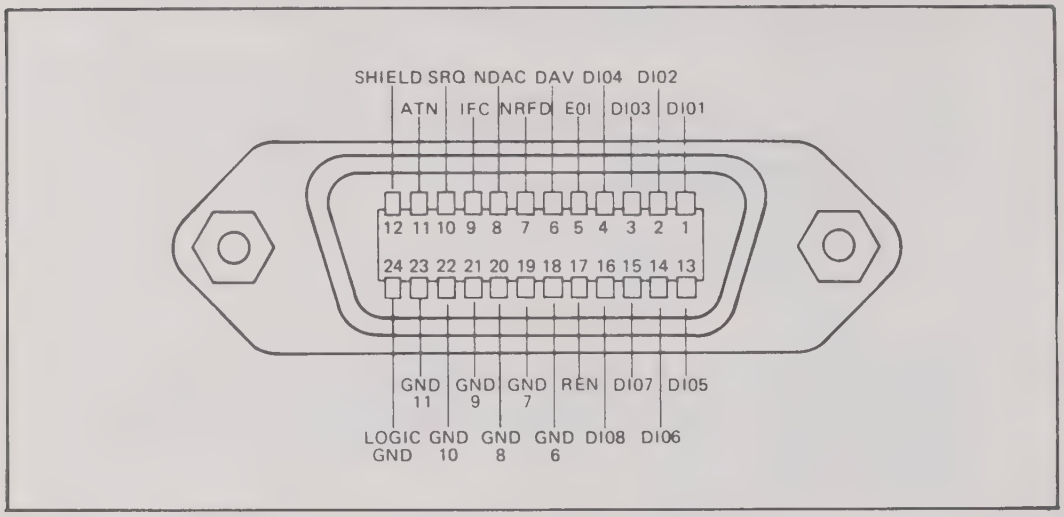


Figure 5-1. IEEE-488 Connector Pin Assignments

REMOTE PROGRAM EXAMPLES 5-49.

The following programs are written in BASIC for the Fluke 1722A Instrument Controller.

Printing Main Output Calibration Shift Results 5-50.

This program generates a printout of the changes in the magnitude of self correction generated at the last calibration. The printout contains the following information:

- A heading that shows the date, time, and 5700A serial number
- Modules present (installed or attached)
- The most recent calibration dates and temperatures
- Data about the external standards used
- Values of the externally-calibrated internal references
- DC voltage output shifts for each range
- AC voltage output shifts for each range
- AC and dc current output shifts for each range
- Resistance shifts for each value
- 5725 Boost Amplifier output shifts (if attached)
- Wideband AC Module (Option 5700-03) output shifts (if installed)

```
10  REM  THIS PROGRAM GENERATES A PRINTOUT OF
20  REM  MAIN OUTPUT SHIFT RESULTS
30  INIT PORT 0                ! INITIALIZE THE INTERFACE
40  CLEAR PORT 0               ! SET THE 5700A TO ITS POWER-UP STATE
50  PRINT @4, "CAL_PR CAL"     ! START CAL REPORT PRINTING
60  END
```

Verifying a Meter 5-51.

The following program was written in Fluke BASIC for the 1722A Instrument Controller. This program selects 10V dc output, verifies that the 5700A is set to 10V, then triggers an 8840A to take a reading. It displays 5700A output, 8840A reading, and the meter error in ppm. The program assumes that the 5700A bus address is 4 and the 8840A bus address is 1.

```
10  REM  THIS PROGRAM VERIFIES THE ACCURACY OF AN 8840A AT 10V DC
20  INIT PORT 0                        ! INITIALIZE THE INTERFACE
30  CLEAR PORT 0                       ! "
40  PRINT @1, "F1 R0 S0 T2"            ! SET 8840A FOR VDC, SLOW READ, AUTORANGE
50  PRINT @4, "OUT 10 V ; OPER"        ! SET THE 5700A TO 10V DC,
60  PRINT @4, "*WAI; OUT?"             ! WAIT FOR SETTLE, REQUEST THE OUTPUT VALUE
70  INPUT @4, V,U$,F                   ! GET THE DATA FROM THE 5700A
80  PRINT @1, "?"                      ! TRIGGER THE 8840A TO TAKE A READING
90  INPUT @1, VM                       ! GET THE DATA FROM THE 8840A
100 ER = ABS(V - VM)/V * 1E6           ! COMPUTE ERROR
110 PRINT "5700 OUTPUT:   ";V;U$       ! PRINT THE RESULTS
120 PRINT "8840 MEASURED: ";VM;"V"  !
130 PRINT "ERROR:         ";ER;"PPM"
140 END
```

Calibrating the 5700A Remotely 5-52.

You can calibrate the 5700A remotely instead of using the front panel controls. For external calibration, you need to make connections to the 5700A binding posts during the process, and you need to change the position of the rear panel CALIBRATION switch. The following paragraphs contain samples of each of the following programs:

- DC Zeros
- Calibration
- Calibration check
- Wideband AC Module (Option 5700A-03) gain calibration

DC ZEROS 5-53.

```
10  PRINT "Starting Zeros Calibration. Please wait . . ."
20  PRINT @4,"CAL_ZERO;*OPC?"          ! 5700A ADDRESS IS 4
30  INPUT @4, A
40  PRINT "Zeros calibration is finished."
50  END
```

```
10  ! THIS IS A PROGRAM FOR REMOTE MAIN OUTPUT CALIBRATION
20  !
25  REMOTE
30  PRINT @4, "*CLS; *SRE 8"                    ! ENABLE EAV TO TRIGGER SRQ
40  ON SRQ GOTO 60                              ! SRQ HANDLER
50  GOTO 140                                    ! START MAIN PROGRAM
60  PRINT @4, "FAULT?" \ INPUT @4, A%           ! SRQ HANDLER, GET FAULT CODE
70  IF A% = 0 GOTO 120                          ! IF NO FAULT EXIT
80  PRINT @4, "EXPLAIN? ";A% \ INPUT @4, A$     ! GET EXPLANATION
90  PRINT
100 PRINT "FAULT";A%;"OCCURRED: ";A$            ! DISPLAY EXPLANATION
110 GOTO 60                                     ! GET NEXT FAULT
120 A% = SPL(4%)                                ! SERIAL POLL TO CLEAR SP BYTE
130 RESUME 530                                  ! END OF SRQ HANDLER
140 PRINT "Ambient temperature in Celsius";     ! MAIN PROGRAM BEGINS
150 INPUT T                                     ! GET TEMPERATURE FROM OPERATOR
160 PRINT @4, "CAL_TEMP";T                      ! SET CAL TEMPERATURE
170 PRINT "Connect the 10V standard as shown in the manual" \ GOSUB 470
180 PRINT "Enter the true value of 10V standard in volts"; \ INPUT V
190 PRINT "Doing 10V reference calibration. Please wait ..."
200 PRINT @4, "CAL_REF ";V;"V;*OPC" \ GOSUB 490
210 PRINT "Reverse the polarity of the leads" \ GOSUB 470
220 PRINT "Doing -10V reference calibration. Please wait ..."
230 V = -V                                      ! SET THE VARIABLE FOR -10V CAL
240 PRINT @4, "CAL_REF ";V;"V;*OPC" \ GOSUB 490
250 PRINT "Connect the 10 kilohm standard to the output terminals"\GOSUB 470
260 PRINT "Enter the true value of the 10 kilohm standard in kilohms";
270 INPUT K1
280 PRINT "Doing 10 kilohm reference calibration. Please wait ..."
290 PRINT @4, "CAL_REF ";K1;"KOHM;*OPC" \ GOSUB 490
300 PRINT "Connect the 1 ohm standard to the output terminals"\GOSUB 470
310 PRINT "Enter the true value of the 1 ohm standard in ohms"; \ INPUT K2
320 PRINT "Doing 1 ohm reference calibration. Please wait ..."
330 PRINT @4, "CAL_REF ";K2;"OHM;*OPC" \ GOSUB 490
340 PRINT "Doing internal portion of calibration. Please wait ..."
350 PRINT @4, "CAL_ADJ;*OPC" \ GOSUB 490
360 PRINT "Calibration finished. Print a calibration report? [y, n]"
370 INPUT A$ \ IF LEFT(A$,1)="N" OR LEFT(A$,1)="n" GOTO 400
380 PRINT "Set up the peripheral device." \ GOSUB 470
390 PRINT "Printing . . ." \ PRINT @4, "CAL_PR CHECK;*OPC" \ GOSUB 490
400 PRINT "Store or discard the constants? [s, d]" \ INPUT A$
410 IF LEFT(A$,1)="D" OR LEFT(A$,1)="d" GOTO 530
420 PRINT "Set the CALIBRATION switch to ENABLE" \ GOSUB 470
430 PRINT "Saving the constants in memory . . ."
440 PRINT @4, "CAL_STORE;*OPC" \ GOSUB 490  ! SAVE THE CONSTANTS IN MEMORY
450 PRINT "Set the CALIBRATION switch to NORMAL" \ GOSUB 470 \ GOTO 530
470 PRINT "Press RETURN to continue"            ! PAUSE FOR OPERATOR SUBROUTINE
480 INPUT A$ \ RETURN                           ! "
490 PRINT @4, "*ESR?" \ INPUT @4, A%            ! WAIT FOR OPC SUBROUTINE
510 IF A% AND 1% THEN RETURN                    ! ", RETURN IF OPC BIT IS 1
520 GOTO 490                                    ! ", STAY IN LOOP IF OPC IS 0
530 PRINT "All finished!" \END
```

CALIBRATION CHECK

5-55.

```
10  ! THIS IS A PROGRAM FOR REMOTE CALIBRATION CHECK
20  !
30  REMOTE
40  PRINT @4, "*CLS; *SRE 8"                    ! ENABLE EAV TO TRIGGER SRQ
50  ON SRQ GOTO 70                              ! SRQ HANDLER
60  GOTO 150                                    ! START MAIN PROGRAM
70  PRINT @4, "FAULT?" \ INPUT @4, A%           ! SRQ HANDLER, GET FAULT CODE
80  IF A% = 0 GOTO 130                          ! IF NO FAULT EXIT
90  PRINT @4, "EXPLAIN? ";A% \ INPUT @4, A$     ! GET EXPLANATION
100 PRINT
110 PRINT "FAULT";A%;"OCCURRED: ";A$            ! DISPLAY EXPLANATION
120 GOTO 70                                     ! GET NEXT FAULT
130 A% = SPL(4%)                                ! SERIAL POLL TO CLEAR SP BYTE
140 RESUME 300                                  ! END OF SRQ HANDLER
150 PRINT "Ambient temperature in Celsius";     ! MAIN PROGRAM BEGINS
160 INPUT T                                     ! GET TEMPERATURE FROM OPERATOR
170 PRINT @4, "CAL_TEMP";T                      ! SET CAL TEMPERATURE
180 PRINT "Doing calibration check. Please wait . . ."
190 PRINT @4, "CAL_CHK;*OPC" \ GOSUB 270
200 PRINT "Calibration check finished. Print a report? [y, n]"
210 INPUT A$ \ IF LEFT(A$,1)="N" OR LEFT(A$,1)="n" GOTO 300
220 PRINT "Set up the peripheral device." \ GOSUB 250
230 PRINT "Printing ..." \ PRINT @4, "CAL_PR CHECK;*OPC" \ GOSUB 270 \ GOTO 300
250 PRINT "Press RETURN to continue"            ! PAUSE FOR OPERATOR SUBROUTINE
260 INPUT A$ \ RETURN                           ! "
270 PRINT @4, "*ESR?" \ INPUT @4,A%             ! WAIT FOR OPC SUBROUTINE
280 IF A% AND 1% THEN RETURN                    ! ", RETURN IF OPC BIT IS 1
290 GOTO 270                                    ! ", STAY IN LOOP IF OPC IS 0
300 PRINT "All finished!" \END
```

WIDEBAND AC MODULE (OPTION 5700A-03) GAIN CALIBRATION 5-56.

```
10  ! THIS IS A PROGRAM FOR REMOTE WIDEBAND (OPTION -03) GAIN CALIBRATION
20  ! WHICH IS PART OF ROUTINE CALIBRATION IF A WIDEBAND MODULE IS INSTALLED
30  !
40  REMOTE
50  PRINT @4, "*CLS ; *SRE 8"                    ! ENABLE FAULT TO TRIGGER SRQ
60  ON SRQ GOTO 80                               ! SRQ HANDLER
70  GOTO 150                                     ! START MAIN PROGRAM
80  PRINT @4, "FAULT?" \ INPUT @4, A%            ! SRQ HANDLER, GET FAULT CODE
90  IF A% = 0 GOTO 130                           ! IF NO FAULT EXIT
100 PRINT @4, "EXPLAIN? ";A% \ INPUT @4, A$      ! GET EXPLANATION
110 PRINT "FAULT";A%;"OCCURRED: ";A$             ! DISPLAY EXPLANATION
120 GOTO 80                                      ! GET NEXT FAULT
130 A% = SPL(4%)                                 ! SERIAL POLL TO CLEAR SP BYTE
140 RESUME 420
150 PRINT "Ambient temperature in Celsius";      ! MAIN PROGRAM BEGINS
160 INPUT T                                      ! GET TEMPERATURE FROM OPERATOR
170 PRINT @4, "CAL_TEMP";T                       ! SET CAL TEMPERATURE
180 PRINT "Connect the wideband cable to the SENSE binding posts through the"
190 PRINT "50 ohm terminator with shield to LO as shown in the manual."
200 GOSUB 370                                    ! PAUSE FOR KEY
210 PRINT "Calibrating wideband positive gain, please wait ..."
220 PRINT @4, "CAL_WBGAIN PGAIN;*OPC" \ GOSUB 390  ! CALIBRATES POSITIVE GAIN
230 PRINT "Reverse the polarity at the SENSE binding posts."
240 GOSUB 370                                    ! PAUSE FOR KEY
250 PRINT "Calibrating wideband negative gain, please wait ..."
260 PRINT @4, "CAL_WBGAIN NGAIN;*OPC" \ GOSUB 390  ! CALIBRATES NEGATIVE GAIN
270 PRINT "Wideband gains calibration finished. Print a report? [y, n]"
280 INPUT A$ \ IF LEFT(A$,1)="N" OR LEFT(A$,1)="n" GOTO 310
290 PRINT "Set up the peripheral device." \ GOSUB 370
300 PRINT "Printing . . ." \ PRINT @4, "CAL_PR CHECK;*OPC" \ GOSUB 390
310 PRINT "Store or discard the constants? [s, d]" \ INPUT A$
320 IF LEFT(A$,1)="D" OR LEFT(A$,1)="d" GOTO 420
330 PRINT "Set the CALIBRATION switch to ENABLE" \ GOSUB 370
340 PRINT "Saving the constants in memory . . ."
350 PRINT @4,"CAL_WBGAIN STORE;*OPC" \ GOSUB 390  ! SAVE THE CONSTANTS
360 PRINT "Set the CALIBRATION switch to NORMAL" \ GOSUB 370 \ GOTO 420
370 PRINT "Press RETURN to continue"             ! PAUSE FOR OPERATOR SUBROUTINE
380 INPUT A$ \ RETURN                            ! "
390 PRINT @4, "*ESR?"  \ INPUT @4,A%             ! WAIT FOR OPC SUBROUTINE
400 IF A% AND 1% THEN RETURN                     ! ", RETURN IF OPC BIT IS 1
410 GOTO 390                                     ! ", STAY IN LOOP IF OPC IS 0
420 PRINT "All finished!" \ END
```

Using *OPC?, *OPC, and *WAI 5-57.

The *OPC?, *OPC, and *WAI commands let you maintain control of the order of execution of commands that could otherwise be passed up by subsequent commands.

If you had sent an "OUT" command, you can check if the output has settled by sending the query "*OPC?." As soon as the "OUT" command has completed (output settled), a "1" appears in the output buffer. You should always follow a *OPC? command with a read command (for example, in Fluke BASIC, "INPUT @4, A"). The read command causes program execution to pause until the addressed instrument responds. The following sample program shows how you can use *OPC?

```
10  PRINT @4, "OUT 100V,1KHZ;OPER; *OPC?"! 5700A ADDRESS IS 4
20  INPUT @4, A                          ! READ THE "1" FROM THE 5700A
30  !PROGRAM HALTS HERE UNTIL A "1" IS PUT INTO THE OUTPUT BUFFER
40  PRINT "OUTPUT SETTLED"
```

The *OPC command is similar in operation to the *OPC? query, except that it sets bit 0 (OPC for "Operation Complete") in the Event Status Register to 1 rather than sending a "1" to the output buffer. One simple use for *OPC is to include it in a program in order for it to generate an SRQ (Service Request). Then an SRQ handler written into the program can detect the operation complete condition and respond appropriately. You can use *OPC similarly to *OPC?, except your program must read the ESR to detect the completion of all operations. The following sample program shows how you can use *OPC.

```
10  REMOTE
20  PRINT @4, "OUT 100V,10HZ;*OPC"   ! 5700A ADDRESS IS 4
30  PRINT @4, "*ESR?"                ! PUT THE ESR BYTE IN BUFFER
40  INPUT @4, A%                     ! READ THE ESR BYTE
50  IF (A% AND 1%) = 0% GOTO 30       ! TRY AGAIN IF NO OPC
60  PRINT "OUTPUT SETTLED"
70  END
```

The *WAI command causes the 5700A to wait until any prior commands have been completed before continuing on to the next command, and takes no other action. Using *WAI is a convenient way to halt operation until the command or commands preceding it have completed. The following sample program shows how you can use *WAI.

```
10  REMOTE
20  PRINT @4, "OUT 100V,10HZ;*WAI"    ! 5700A ADDRESS IS 4
30  PRINT @4, "OUT?"                  ! READ THE OUTPUT VALUE
40  INPUT @4, A$,B$,C$                ! A$ CONTAINS THE OUTPUT VALUE
50  PRINT "OUTPUT SETTLED"
60  PRINT "OUTPUT IS: ";A$;B$;" at ";C$
70  END
```

Section 6
Using the RS-232-C Serial Interface

CONTENTS

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INTRODUCTION 6-1.

This section describes how to set up the RS-232-C interface for remote control using protocol similar to IEEE-488, or to print or transmit data from the calibrator. Once you set up the interface for remote control, refer to Section 5 for full details of remote operation. This section provides all details on printing or transmitting data.

The calibrator's RS-232-C interface is designed in accordance with EIA (Electronic Industries Association) standard RS-232-C. Through its RS-232-C interface, the 5700A can be remotely controlled; and it can transmit its internal calibration constant values and other information to a printer, video-display terminal, or host computer.

RS-232-C INTERFACE SPECIFICATIONS 6-2.

The RS-232-C interface is configured as DTE (Data Terminal Equipment). A null-modem cable with two female 25-pin subminiature D connectors must be used to connect the 5700A to other DTE (Data Terminal Equipment) such as printers, video-display terminals, or computers. Recommended cables are Fluke accessories Y1702 or Y1703.

The pinout for the 5700A RS-232-C Connector is shown in Figure 6-1. The choices available and the defaults for all programmable interface parameters are shown in Table 6-1.

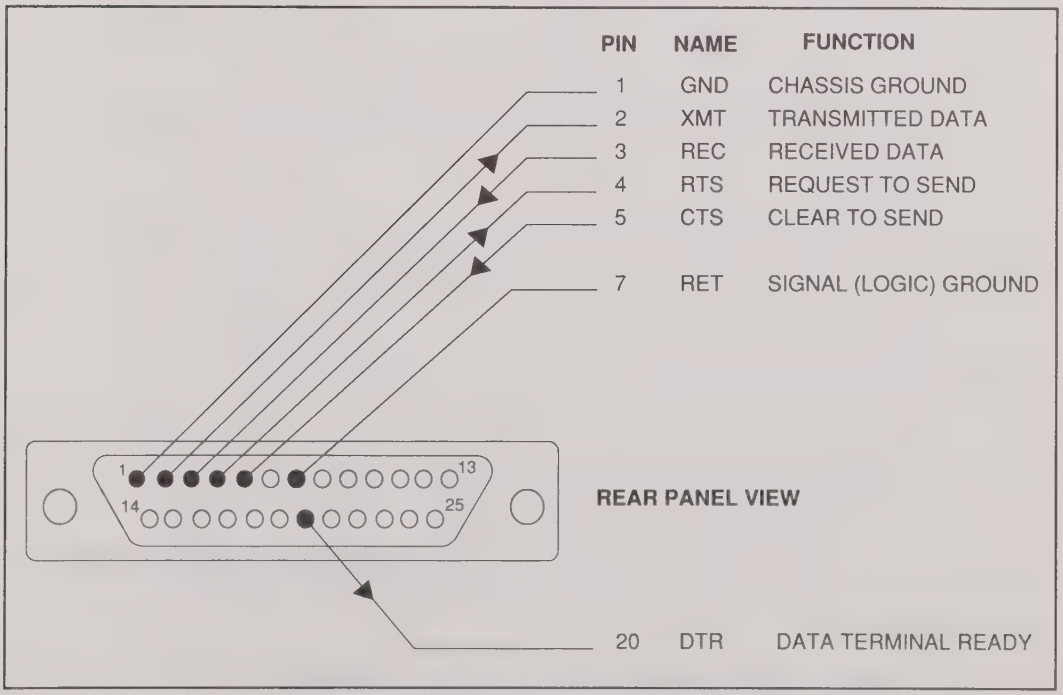


Figure 6-1. RS-232-C Connector Pinout

Table 6-1. RS-232-C Interface Parameter Choices

PARAMETER	CHOICES	DEFAULT SETTING
Data Bits	7 or 8	8
Stop Bits	1 or 2	1
Flow Control	Ctrl S/Ctrl Q (XON/XOFF), RTS, or none	Ctrl S/Ctrl Q
Parity Checking	Odd, even, or none	None
Baud Rate	110, 300, 600, 1200, 2400, 4800, 9600, or 19200	9600
Timeout Period	0 to 30 seconds	0 (No timeout)
EOL (End Of Line)	CR, LF, or CR LF	CR LF
EOF (End Of File)	Any two ASCII characters	No characters

SETTING UP AND CONNECTING THE SERIAL INTERFACE 6-3.

Refer to the specifications for your peripheral device, and proceed as follows to set up the serial interface for your application:

1. Turn the power off.
2. Connect an RS-232-C null-modem cable such as Fluke accessory Y1702 or Y1703 to the rear panel RS-232-C connector and to the peripheral device.
3. Turn the power on.
4. Press the following sequence of softkeys:

"Setup Menus" —> "Instmt Setup" —> "Remote Port Setup" —> "RS-232 Port Setup"

The display changes to:

5. Set the number of data bits with the "data bits" softkey.
6. Set the number of stop bits with the "stop bits" softkey.
7. Select a method of stall control with the "Stall" softkey.
8. Select the parity mode with the "Parity" softkey.

9. Press the "Next menu" softkey. The display changes to:

10. Set the baud rate with the "baud" softkey.

11. Set the timeout period with the "shortr" or "longer" softkey. (Timeout is the length of time the calibrator waits before aborting the current process after receiving a flow control command, and is programmable between 0 to 30 seconds. A setting of 0 causes the calibrator to wait forever after receiving a stall command.)

12. Press the "EOL" softkey to set the EOL (End Of Line) character to either CR, LF, or the string CR LF.

13. Press the "NEXT menu" softkey. The display changes to:

14. This step needs to be done only if you are setting up the interface for remote control of the calibrator. Press one of the softkeys under "Remote I/F" to set the label to "TERMINAL" or "COMPUTER".

    "TERMINAL" sets the remote port to expect a human operator to be using a terminal attached to the RS-232-C port to control the calibrator. This setting has the same effect as specifying "TERM" in the SP__SET remote command parameter string.

    "COMPUTER" sets the remote port to expect a computer to be controlling the calibrator over the RS-232-C port. This setting has the same effect as specifying "COMP" in the SP__SET remote command parameter string.

15. To designate a character or character string as the EOF (End Of File) character, press the "EOF" softkey. The display changes to:

16. Enter the decimal code of the ASCII (American Standard Code for Information Interchange) character or characters to be designated as EOF. (Appendix C contains a table of ASCII codes.) Verify that your selection is correct as shown on the display.

17. To exit the setup menus, press PREV MENU five times.

PRINTING CALIBRATION REPORTS 6-4.

Calibration reports are available for calibration check and calibration. The following paragraphs describe what you can print and how to do it.

NOTE

Reports can only be printed through the serial port when it is not being used as the remote control port.

Calibration Shift Results 6-5.

The Calibration Shift Results printout gives you adjustments made to stored zero-offset and gain constants, as a result of drift detected at the last calibration. The printout contains the following information:

- Heading that shows the date, time, and user report string
- Modules present (installed or attached)
- Most recent calibration dates and temperatures
- Space to record information about external standards used
- Values of externally-calibrated internal references
- DC voltage output shifts for each range
- AC voltage output shifts for each range
- Current output shifts for each range (ac and dc)
- Resistance shifts for each value
- 5725 Amplifier output shifts (if attached)
- Wideband AC Module (Option 5700A-03) output shifts (if installed)

A sample calibration report is shown in Figure 6-2. Table 6-3 contains annotations for items with number callouts in Figure 6-2. Both calibration shift results and calibration check shift results have the format shown in Figure 6-2.

Calibration Check Shift Results 6-6.

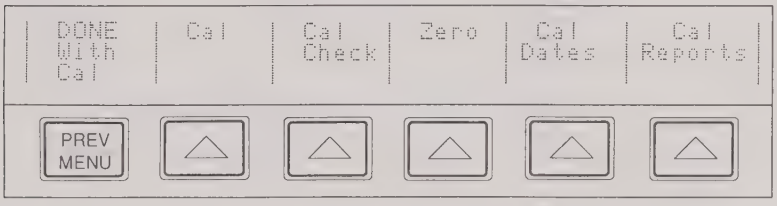
The Calibration Check Shift Results printout gives you the changes in the magnitude of self correction generated by calibration check. Calibration check uses internal standards rather than external standards as the basis for comparison, and does not make permanent changes to calibration constants. Section 1 describes how to use calibration check to develop a performance history. The printout contains the following information:

- Heading that shows the date, time, and user report string
- Modules present (installed or attached)
- Most recent calibration dates and temperatures
- Values of externally-calibrated internal references
- DC voltage output shifts for each range
- AC voltage output shifts for each range
- AC and dc current output shifts for each range
- Resistance shifts for each value
- 5725 Boost Amplifier output shifts (if attached)

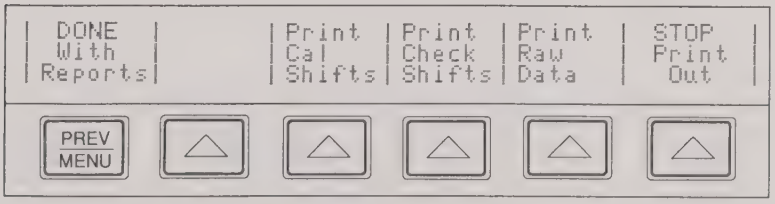
Generating a Printout 6-7.

After configuring the serial interface for compatibility with your peripheral device and attaching an RS-232-C cable, proceed as follows from the power-up state to transmit calibration shift results:

1. Press the "Setup Menus" softkey then the "Cal" softkey. The calibration menu appears:



2. Press the "Cal Reports" softkey. The calibration reports menu appears:

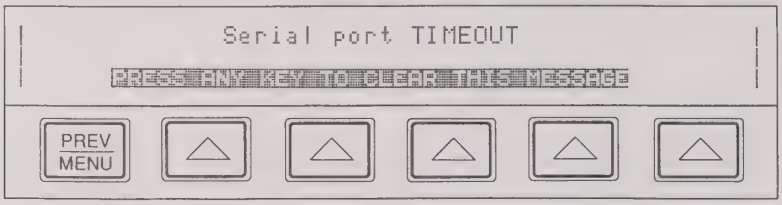


3. To print the main output calibration shift results as shown in Figure 6-2, press the "Print Cal Shifts" softkey.

4. To print the calibration check shift results (similar to Figure 6-2), press the "Print Check Shifts" softkey.

5. To print raw calibration constant data, press the "Print Raw Data" softkey.

The printout begins if the interface parameters are set up correctly and the cable wiring is correct for the peripheral device. If the input buffer of the peripheral device fills and the device sends the 5700A a stall command, the 5700A stops sending data and starts a timer. If the timeout period expires, printing is aborted and the following message appears on the display:



The message disappears when you press a key.

Line Feed characters are embedded in the data stream so that the output is paginated for a 66-line page.

JOHN FLUKE MFG. CO., INC. 5700 OUTPUT CALIBRATION (1)
(2) PRINTED ON 8/30/88 AT 17:04:34 5700A (3)

MODULES PRESENT

Switching Matrix
DC Volt Module
AC Volt Module
220V Module
1100V/2A Module (4)
Current Module
Ohms Module
Hires Osc Module
Rear Panel

CALIBRATION DATES AND TEMPERATURES

Specification Interval: 180day

MAIN OUTPUT: (Most recent) 8/10/88, 23.0 Degrees C (5)
(Previous) 2/10/88, 23.0 Degrees C (6)
(Days since last cal) 20 (7)

ZERO: (Most recent) 8/10/88
(Days since last cal) 20

STANDARDS USED

STANDARD	NUMBER	CERT. DATE	
VOLTAGE			
10 kOhm			
1 Ohm			
OTHER			

EXTERNALLY CALIBRATED INTERNAL REFERENCES

REFERENCE	Most Recent (8)	Previous (9)	Shift (ppm) (10)
6.5 V DC Reference	6.548264	6.548264	0.00
13 V DC Reference	13.082723	13.082723	0.00
10 kOhm Reference	10.002966	10.002960	0.63
1.0 Ohm Resistor	1.0001009	1.0001003	0.61
1.9 Ohm Resistor	1.8992529	1.8992496	1.77

Figure 6-2. Calibration Shift Results Printout

DC VOLTAGE OUTPUT SHIFTS

RANGE (11)	Point (12)	Zero Shift (13)	Full Scale Shift (14)		Spec (+/-) (15)	Shift (% spec) (16)
220 mV	+FS	- 0.00029 mV	- 0.00068 mV	-3.0939 ppm	11.41 ppm	-27.12
	-FS	- 0.00030 mV	0.00006 mV	0.2719 ppm	11.41 ppm	2.38
2.2V	+FS	-0.0000002 V	-0.0000002 V	-0.1018 ppm	7.55 ppm	-1.35
	-FS	-0.0000003 V	-0.0000005 V	-0.2466 ppm	7.55 ppm	-3.27
11V	+FS	0.000000 V	0.000000 V	0.0298 ppm	7.36 ppm	0.41
	-FS	0.000000 V	- 0.000001 V	-0.1150 ppm	7.36 ppm	-1.56
22V	+FS	0.000001 V	0.000001 V	0.0281 ppm	7.36 ppm	0.38
	-FS	- 0.000000 V	- 0.000000 V	-0.0095 ppm	7.36 ppm	-0.13
220V	+FS	- 0.00000 V	0.00003 V	0.1149 ppm	8.45 ppm	1.36
	-FS	- 0.00001 V	- 0.00001 V	-0.0298 ppm	8.45 ppm	-0.35
1100V	+FS	0.0001 V	0.0002 V	0.1790 ppm	10.55 ppm	1.70
	-FS	0.0000 V	0.0000 V	0.0342 ppm	10.55 ppm	0.32

AC VOLTAGE OUTPUT SHIFTS

RANGE	Point		Full Scale Shift		Spec (+/-)	Shift (% spec)
2.2 mV	FS	- 0.000008 mV	-0.0004 %		0.24 %	-0.15
	20.00 kHz	- 0.000008 mV	-0.0003 %		0.24 %	-0.14
	50.00 kHz	- 0.000006 mV	-0.0003 %		0.27 %	-0.11
	100.00 kHz	- 0.000006 mV	-0.0003 %		0.46 %	-0.06
	119.99 kHz	- 0.000016 mV	-0.0007 %		0.81 %	-0.09
	0.1200 MHz	- 0.000015 mV	-0.0007 %		0.81 %	-0.08
	0.2000 MHz	- 0.000016 mV	-0.0007 %		0.81 %	-0.09
	0.3000 MHz	- 0.000008 mV	-0.0004 %		0.81 %	-0.04
	0.4000 MHz	- 0.000007 mV	-0.0003 %		1.53 %	-0.02
	0.5000 MHz	- 0.000020 mV	-0.0009 %		1.53 %	-0.06
	0.6000 MHz	- 0.000005 mV	-0.0002 %		1.71 %	-0.01
	0.7000 MHz	- 0.000005 mV	-0.0002 %		1.71 %	-0.01
	0.8000 MHz	- 0.000004 mV	-0.0002 %		1.71 %	-0.01
	0.9000 MHz	- 0.000007 mV	-0.0003 %		1.71 %	-0.02
	1.0000 MHz	0.000004 mV	0.0002 %		1.71 %	0.01
	1.1000 MHz	- 0.000004 mV	-0.0002		-1.00	0.00
	1.1999 MHz	0.000001 mV	0.0000		-1.00	0.00
22 mV	FS	- 0.00005 mV	-2.3999 ppm		392.73 ppm	-0.61
	20.00 kHz	0.00003 mV	1.2884 ppm		392.73 ppm	0.33
	50.00 kHz	- 0.00008 mV	-3.7243 ppm		662.73 ppm	-0.56
	100.00 kHz	- 0.00003 mV	-0.0001 %		0.13 %	-0.10
	119.99 kHz	- 0.00003 mV	-0.0001 %		0.20 %	-0.06
	0.1200 MHz	- 0.00001 mV	0.0000 %		0.20 %	-0.02
	0.2000 MHz	- 0.00009 mV	-0.0004 %		0.20 %	-0.22
	0.3000 MHz	- 0.00010 mV	-0.0005 %		0.20 %	-0.24
	0.4000 MHz	- 0.00008 mV	-0.0004 %		0.31 %	-0.13
	0.5000 MHz	- 0.00011 mV	-0.0005 %		0.31 %	-0.16
	0.6000 MHz	- 0.00008 mV	-0.0004 %		0.49 %	-0.08
	0.7000 MHz	- 0.00001 mV	-0.0001 %		0.49 %	-0.01
	0.8000 MHz	- 0.00011 mV	-0.0005 %		0.49 %	-0.10
	0.9000 MHz	- 0.00013 mV	-0.0006 %		0.49 %	-0.12
	1.0000 MHz	- 0.00011 mV	-0.0005 %		0.49 %	-0.10
	1.1000 MHz	- 0.00012 mV	-0.0005		-1.00	0.00
	1.1999 MHz	- 0.00016 mV	-0.0007		-1.00	0.00
220 mV	FS	- 0.0004 mV	-1.6873 ppm		155.45 ppm	-1.09
	20.00 kHz	- 0.0003 mV	-1.5560 ppm		155.45 ppm	-1.00
	50.00 kHz	- 0.0002 mV	-0.8993 ppm		395.45 ppm	-0.23
	100.00 kHz	- 0.0002 mV	-0.6917 ppm		986.36 ppm	-0.07
	119.99 kHz	- 0.0012 mV	-0.0005 %		0.12 %	-0.44
	0.1200 MHz	- 0.0011 mV	-0.0005 %		0.12 %	-0.39
	0.2000 MHz	- 0.0012 mV	-0.0006 %		0.12 %	-0.45
	0.3000 MHz	- 0.0004 mV	-0.0002 %		0.12 %	-0.14
	0.4000 MHz	- 0.0003 mV	-0.0001 %		0.19 %	-0.07
	0.5000 MHz	- 0.0016 mV	-0.0007 %		0.19 %	-0.38
	0.6000 MHz	- 0.0001 mV	-0.0001 %		0.40 %	-0.01
	0.7000 MHz	- 0.0001 mV	0.0000 %		0.40 %	-0.01
	0.8000 MHz	0.0000 mV	0.0000 %		0.40 %	0.00
	0.9000 MHz	- 0.0002 mV	-0.0001 %		0.40 %	-0.03
	1.0000 MHz	0.0009 mV	0.0004 %		0.40 %	0.10
	1.1000 MHz	0.0000 mV	0.0000		-1.00	0.00
	1.1999 MHz	0.0005 mV	0.0002		-1.00	0.00

Figure 6-2. Calibration Shift Results Printout (cont)

2.2V	FS			0.000000	V	0.0679	ppm	83.18	ppm	0.08
	20.00	kHz		0.000000	V	0.1993	ppm	83.18	ppm	0.24
	50.00	kHz		0.000002	V	0.8559	ppm	149.09	ppm	0.57
	100.00	kHz		0.000002	V	1.0635	ppm	306.36	ppm	0.35
	119.99	kHz	-	0.000008	V	-3.6877	ppm	538.18	ppm	-0.69
	0.1200	MHz	-	0.000007	V	-3.1058	ppm	538.18	ppm	-0.58
	0.2000	MHz	-	0.000008	V	-3.7954	ppm	538.18	ppm	-0.71
	0.3000	MHz		0.000000	V	0.0459	ppm	538.18	ppm	0.01
	0.4000	MHz		0.000001	V	0.0000	%	0.14	%	0.03
	0.5000	MHz	-	0.000012	V	-0.0005	%	0.14	%	-0.40
	0.6000	MHz		0.000003	V	0.0001	%	0.29	%	0.04
	0.7000	MHz		0.000003	V	0.0001	%	0.29	%	0.05
	0.8000	MHz		0.000004	V	0.0002	%	0.29	%	0.06
	0.9000	MHz		0.000002	V	0.0001	%	0.29	%	0.02
	1.0000	MHz		0.000012	V	0.0006	%	0.29	%	0.20
	1.1000	MHz		0.000004	V	0.0002		-1.00		0.00
	1.1999	MHz		0.000009	V	0.0004		-1.00		0.00
22V	FS			0.00003	V	1.2657	ppm	83.18	ppm	1.52
	20.00	kHz		0.00011	V	4.9540	ppm	83.18	ppm	5.96
	50.00	kHz	-	0.00000	V	-0.0587	ppm	149.09	ppm	-0.04
	100.00	kHz		0.00005	V	2.4146	ppm	288.18	ppm	0.84
	119.99	kHz		0.00005	V	2.4585	ppm	627.27	ppm	0.39
	0.1200	MHz		0.00007	V	3.3018	ppm	627.27	ppm	0.53
	0.2000	MHz	-	0.00001	V	-0.6048	ppm	627.27	ppm	-0.10
	0.3000	MHz	-	0.00002	V	-1.0205	ppm	627.27	ppm	-0.16
	0.4000	MHz	-	0.00000	V	0.0000	%	0.15	%	-0.01
	0.5000	MHz	-	0.00003	V	-0.0001	%	0.15	%	-0.08
	0.6000	MHz		0.00000	V	0.0000	%	0.33	%	0.00
	0.7000	MHz		0.00007	V	0.0003	%	0.33	%	0.09
	0.8000	MHz	-	0.00003	V	-0.0001	%	0.33	%	-0.04
	0.9000	MHz	-	0.00005	V	-0.0002	%	0.33	%	-0.07
	1.0000	MHz	-	0.00003	V	-0.0001	%	0.33	%	-0.04
	1.1000	MHz	-	0.00003	V	-0.0002		-1.00		0.00
	1.1999	MHz	-	0.00008	V	-0.0004		-1.00		0.00
220V	FS		-	0.0007	V	-3.3918	ppm	91.55	ppm	-3.71
	5.000	kHz		0.0002	V	0.8776	ppm	91.55	ppm	0.96
	10.000	kHz	-	0.0003	V	-1.2022	ppm	91.55	ppm	-1.31
	20.00	kHz	-	0.0009	V	-4.1578	ppm	91.55	ppm	-4.54
	50.00	kHz	-	0.0009	V	-4.1580	ppm	158.18	ppm	-2.63
	100.00	kHz	-	0.0011	V	-5.1449	ppm	395.45	ppm	-1.30
	119.99	kHz	-	0.0001	V	-0.0001	%	0.11	%	-0.05
	0.1200	MHz	-	0.0001	V	-0.0001	%	0.11	%	-0.06
	0.2000	MHz	-	0.0030	V	-0.0014	%	0.11	%	-1.28
	0.3000	MHz	-	0.0002	V	-0.0001	%	0.11	%	-0.07
	0.4000	MHz	-	0.0076	V	-0.0035	%	0.28	%	-1.24
	0.5000	MHz		0.0047	V	0.0022	%	0.28	%	0.77
	0.6000	MHz	-	0.0041	V	-0.0019	%	0.45	%	-0.41
	0.7000	MHz	-	0.0035	V	-0.0016	%	0.45	%	-0.35
	0.8000	MHz	-	0.0130	V	-0.0059	%	0.45	%	-1.31
	0.9000	MHz	-	0.0141	V	-0.0064	%	0.45	%	-1.42
	1.0000	MHz	-	0.0314	V	-0.0143	%	0.45	%	-3.17
1100V	FS			0.001	V	1.3336	ppm	88.64	ppm	1.50
	0.3000	kHz		0.021	V	18.8211	ppm	88.64	ppm	21.23
	0.5000	kHz	-	0.002	V	-1.6375	ppm	88.64	ppm	-1.85
	0.7000	kHz		0.014	V	12.3123	ppm	88.64	ppm	13.89
	1.0000	kHz		0.002	V	1.5134	ppm	88.64	ppm	1.71

DC CURRENT OUTPUT SHIFTS

RANGE	Point	Zero Shift		Full Scale Shift			Spec (+/-)		Shift (% spec)
220 uA	+FS	0.0000	uA	- 0.0002	uA	-1.1163	ppm	100.45	ppm	-1.11
	-FS	0.0000	uA	0.0003	uA	1.2771	ppm	100.45	ppm	1.27
2.2 mA	+FS	0.000000	mA	- 0.000003	mA	-1.1689	ppm	59.55	ppm	-1.96
	-FS	0.000000	mA	0.000003	mA	1.2342	ppm	59.55	ppm	2.07
22 mA	+FS	- 0.00000	mA	0.00006	mA	2.5646	ppm	59.55	ppm	4.31
	-FS	- 0.00000	mA	- 0.00006	mA	-2.6637	ppm	59.55	ppm	-4.47
220 mA	+FS	- 0.0000	mA	0.0008	mA	3.7483	ppm	69.55	ppm	5.39
	-FS	- 0.0001	mA	- 0.0009	mA	-4.2078	ppm	69.55	ppm	-6.05
2.2A	+FS	- 0.000001	A	0.000024	A	11.0582	ppm	103.64	ppm	10.67
	-FS	- 0.000001	A	- 0.000026	A	-11.6253	ppm	103.64	ppm	-11.22

Figure 6-2. Calibration Shift Results Printout (cont)

AC CURRENT OUTPUT SHIFTS

RANGE	Point		Full Scale Shift		Spec (+/-)	Shift (% spec)
220 uA	FS		0.000 uA	0.0502 ppm	240.91 ppm	0.02
	0.5000	kHz	- 0.000 uA	-0.6841 ppm	240.91 ppm	-0.28
	1.0000	kHz	0.000 uA	1.7479 ppm	240.91 ppm	0.73
	2.000	kHz	- 0.001 uA	-0.0004 %	0.53 %	-0.08
	5.000	kHz	0.001 uA	0.0004 %	0.53 %	0.08
	7.000	kHz	- 0.000 uA	-0.0002 %	2.28 %	-0.01
	10.000	kHz	0.000 uA	0.0001 %	2.28 %	0.00
2.2 mA	FS		0.00000 mA	0.0454 ppm	168.18 ppm	0.03
	0.5000	kHz	0.00000 mA	2.0199 ppm	168.18 ppm	1.20
	1.0000	kHz	0.00000 mA	0.7800 ppm	168.18 ppm	0.46
	2.000	kHz	- 0.00000 mA	0.0000 %	0.17 %	-0.01
	5.000	kHz	0.00000 mA	0.0002 %	0.17 %	0.11
	7.000	kHz	- 0.00000 mA	-0.0002 %	0.64 %	-0.03
	10.000	kHz	0.00001 mA	0.0003 %	0.64 %	0.05
22 mA	FS		0.0001 mA	3.8610 ppm	168.18 ppm	2.30
	0.5000	kHz	0.0001 mA	4.8723 ppm	168.18 ppm	2.90
	1.0000	kHz	0.0001 mA	5.9438 ppm	168.18 ppm	3.53
	2.000	kHz	0.0001 mA	0.0005 %	0.13 %	0.36
	5.000	kHz	0.0002 mA	0.0008 %	0.13 %	0.63
	7.000	kHz	0.0001 mA	0.0002 %	0.55 %	0.04
	10.000	kHz	0.0001 mA	0.0003 %	0.55 %	0.06
220 mA	FS		0.001 mA	5.2249 ppm	368.18 ppm	1.42
	0.5000	kHz	- 0.000 mA	-0.1709 ppm	368.18 ppm	-0.05
	1.0000	kHz	0.001 mA	6.1403 ppm	368.18 ppm	1.67
	2.000	kHz	0.001 mA	0.0006 %	0.10 %	0.54
	5.000	kHz	0.001 mA	0.0006 %	0.10 %	0.63
	7.000	kHz	0.001 mA	0.0005 %	0.51 %	0.09
	10.000	kHz	0.001 mA	0.0007 %	0.51 %	0.13
2.2A	FS		0.00003 A	12.5886 ppm	718.18 ppm	1.75
	0.5000	kHz	0.00003 A	13.5999 ppm	718.18 ppm	1.89
	1.0000	kHz	0.00003 A	14.6714 ppm	718.18 ppm	2.04
	2.000	kHz	0.00003 A	13.2874 ppm	845.45 ppm	1.57
	5.000	kHz	0.00004 A	16.6697 ppm	845.45 ppm	1.97
	7.000	kHz	0.00002 A	0.0011 %	0.96 %	0.12
	10.000	kHz	0.00003 A	0.0012 %	0.96 %	0.13

RESISTANCE OUTPUT SHIFTS

Point	Full Scale Shift		Spec (+/-)	Shift (% spec)
0.0000000 Ohm	0.0000000 Ohm	0.0000 Ohm	0.00 Ohm	0.00
1.0001003 Ohm	0.0000006 Ohm	0.6056 ppm	100.00 ppm	0.61
1.8992496 Ohm	0.0000034 Ohm	1.7748 ppm	100.00 ppm	1.77
9.998671 Ohm	- 0.000042 Ohm	-4.1569 ppm	30.00 ppm	-13.86
18.996286 Ohm	0.000026 Ohm	1.3871 ppm	28.00 ppm	4.95
99.99441 Ohm	- 0.00028 Ohm	-2.7591 ppm	18.00 ppm	-15.33
189.97928 Ohm	- 0.00008 Ohm	-0.4192 ppm	18.00 ppm	-2.33
0.9999812 kOhm	0.0000012 kOhm	1.1512 ppm	13.00 ppm	8.86
1.9000335 kOhm	0.0000024 kOhm	1.2732 ppm	13.00 ppm	9.79
10.001517 kOhm	0.000008 kOhm	0.7913 ppm	12.00 ppm	6.59
19.001783 kOhm	0.000017 kOhm	0.8730 ppm	12.00 ppm	7.27
100.01554 kOhm	0.00003 kOhm	0.2929 ppm	14.00 ppm	2.09
190.02878 kOhm	0.00009 kOhm	0.4916 ppm	14.00 ppm	3.51
1.0001867 MOhm	0.0000010 MOhm	0.9626 ppm	20.00 ppm	4.81
1.9003566 MOhm	0.0000024 MOhm	1.2565 ppm	21.00 ppm	5.98
10.001948 MOhm	0.000010 MOhm	0.9543 ppm	40.00 ppm	2.39
19.001831 MOhm	0.000045 MOhm	2.3482 ppm	50.00 ppm	4.70
100.04309 MOhm	0.00000 MOhm	0.0238 ppm	125.00 ppm	0.02

Figure 6-2. Calibration Shift Results Printout (cont)

Table 6-2. Annotation for Shift Results Printout

(1) The type of calibration report, 5700 OUTPUT CALIBRATION or 5700 CALIBRATION CHECK.

A 5700 OUTPUT CALIBRATION report shows 5700A offset and gain adjustments done at the last calibration. The report is derived from two sets of calibration constants stored in non-volatile memory: the active set, and the set that was previously active. It is always based on external standards and may be requested at any time.

A 5700A CALIBRATION CHECK report shows proposed 5700A calibration adjustments that will never be stored. This report is available in two forms, depending on when it is requested:

1. You can request a 5700 CALIBRATION CHECK report just after completing a 5700A calibration, but before deciding to store the proposed adjustments. This will allow you to inspect the proposed adjustments before deciding to make them permanent. If they are small in magnitude, you may decide to simply file the report and leave the rear panel CALIBRATION switch in its NORMAL position.

   This form of cal check report includes calibration drift information on internal 5700A check standards, based on the external artifact standards used.

2. A 5700 CALIBRATION CHECK report requested at any other time shows calibrator drift relative to internal check standards, based on data from a just-completed cal check. This form of cal check report includes the statement that the report is based on externally calibrated internal check standards in place of their actual data.

Cal check data remains in memory available for reporting until replaced by a later cal check or calibration, or until a RESET or cycling of the POWER switch.

(2) The date and time that the 5700A printed the report, not the time and date of calibration.

(3) The user report string contents. (Set by the remote RPT__STR command.)

(4) A list of each analog module installed in the 5700A and the external amplifiers attached to the instrument and powered on.

(5) The date and reported temperature of the most recent calibration. This always refers to the calibration that established the set of cal constants presently in use (stored in EEPROM).

NOTE:

5700A calibration check reports also have a line showing the date and temperature of the calibration check, which refers to the calibration that established the set of constants presently in temporary memory. This line is indicated by (CalCheck) and can also refer to constants established by performing output calibration but not yet saved into EEPROM.

(6) The date and temperature of the previous calibration, prior to the most recent one.

(7) The number of days between the day the calibration report was printed (#2 above) and the day that the presently active set of cal constants was stored into EEPROM (#5 above).

(8) The values of each internal reference as established during the most recent calibration. The unit for each value is the same as listed in the reference name, just to the left under the REFERENCE heading.

Table 6-2. Annotation for Shift Results Printout (cont)

(9) The previous value of each internal reference. For 5700 CALIBRATION CHECK, this column is labeled Most Recent and refers to the active constants stored in EEPROM.

(10) The reference shift expressed in parts per million (ppm). The formula used for this calculation is:

$$\frac{1{,}000{,}000 \times (\text{Most Recent} - \text{Previous})}{(\text{Previous})} = \text{shift (ppm)}$$

For 5700 calibration check, the formula is:

$$\frac{1{,}000{,}000 \times (\text{Cal check} - \text{Most Recent})}{(\text{Most Recent})} = \text{shift (ppm)}$$

The remaining pages in the calibration report give information which describe how the output has changed between the time two different calibration activities were performed. (See #1.) The 5700A checks each range at multiple points, as described further on.

(11) This is the name of the range to which the shift information pertains.

(12) The 5700A calculates shift information at multiple points, depending on the range and mode (dc V, ac V, etc.). Each line in the report for a given range contains shift information for a particular point. The "Point" column indicates which point in the range the data is calculated for.

On this example page of DC VOLTAGE OUTPUT SHIFTS, two points are listed for each range, +FS and -FS. +FS refers to the positive full-scale value of the range, as given in the RANGE column. -FS refers to the negative full-scale value for the range. For the 220 mV range, +FS means +220 mV dc and -FS means -220 mV dc. These points are used to calculate the amount of full scale shift, as discussed further on.

(13) This column lists how much the zero output has shifted between calibration events (i.e., comparing the most recent with the previous calibration). Assuming the calibrator output was exactly 0V immediately after the previous calibration, the number listed in this column shows what the calibrator output was just before the most recent calibration was performed. There are two zero checks for each dc range, one for the portion of the range $<$0V and one for the portion $>$0V. The report includes the positive portion zero shifts in the +FS line and the negative portion zero shifts in the -FS line.

For example, the positive portion zero of the 220 mV range shifted from 0.00000 mV to 0.00002 mV between the previous calibration and the most recent calibration. (Listed under the 220 mV range, +FS point.) If this calibration data is stored, all positive outputs on the 220 mV range will be reduced by 0.00002 mV.

(14) As with zero shifts, the 5700A calculates how much the full scale point has shifted between the two calibrations. This is listed in two columns under the "Full Scale Shift" heading. The left column under this heading indicates how much the output shifted expressed in the units of output for the range. For example, the +FS point on the 220 mV range shifted from 220.00000 mV to 220.00057 mV between the previous calibration and just before the most recent calibration.

Table 6-2. Annotation for Shift Results Printout (cont)

The right column under the "Full Scale Shift" heading gives the shift expressed in parts per million (ppm). The formula used is:

shift = 1,000,000 × (full scale shift / full scale range point)

e.g., for the +FS point on the 220 mV range,

shift = 1,000,000 × (0.00057 mV / +220 mV) = 2.59 ppm.

Full scale shift includes all sources of shift at the full scale point that is checked, including both gain and zero shift components. To determine the gain component of the full scale shift, subtract the number in the zero shift column from the number in the left Full Scale Shift column.

e.g. for the -FS point on the 220 mV range:

total shift = -0.00051 mV (left column under Full Scale Shift)
zero shift component = 0.00003 mV (Zero Shift column)
gain shift component = -0.00054 mV (subtract zero shift from total shift)

(15) This column shows 5700A uncertainty at the full-scale point being checked, using the calibration interval specified in the setup menu. (E.g., the total uncertainty at 2.2 V is 8.55 ppm.)

(16) The last column expresses full-scale shift as a percentage of specification. The formula is:

shift (% spec) = 100 × (full scale shift / spec (±))

For full-scale shift, the calibrator always uses the absolute value of the right column under Full Scale Shift.

E.g., for the -FS point on the 220 mV, shift = 100 × (2.32 ppm / 14.64 ppm) = 15.88%.

(17) For ac outputs, the column under the "Point" heading means something slightly different than those for dc outputs:

FS means the 5700A calculates shift at the full scale point for a low frequency where flatness correction constants are not applied. This is the shift as a result of changes in range gain constants. (There is no zero shift component for an ac output.) The 5700A uses the uncertainty (Spec (±) column) for the full-scale point and a frequency of 1 kHz.

For example, the FS point on the 2.2 mV ac range at low frequencies shifted from 2.200000 mV to 2.200006 mV between the previous calibration and just before the most recent calibration.

When the point describes a frequency, the shift in output is calculated at that frequency. This shift shows the effect of changes in output due to flatness correction. The instrument calculates the uncertainty (Spec (±) column) using the full scale point and the frequency listed under the Point column.

For example, the 50.00 kHz point on the 2.2 mV ac range shifted from 2.200000 mV to 2.200009 mV between the previous calibration and just before the most recent calibration.

Section 7
Operator Maintenance

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INTRODUCTION 7-1.

This section explains how to perform the routine maintenance and calibration tasks required to keep a normally operating 5700A Calibrator in service. These tasks include:

- Replacing the fuse
- Cleaning the air filter
- Cleaning the external surfaces
- Calibration

Refer to the 5700A Service Manual for intensive maintenance tasks such as troubleshooting or repair, and all procedures that require opening the cover of the instrument such as moving the active binding post position between the front and rear. The service manual also contains complete verification procedures for checking that traceability to national standards is being maintained by the normal calibration procedure.

ACCESSING THE FUSE 7-2.

The fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder shows the correct replacement fuse ratings for each operating voltage. To access the fuse, refer to Figure 7-1 and proceed as follows:

1. Disconnect line power.

2. Insert the blade of a standard screwdriver in the slot of the fuse holder.

3. Turn the screwdriver counterclockwise until the cap and fuse pop free.

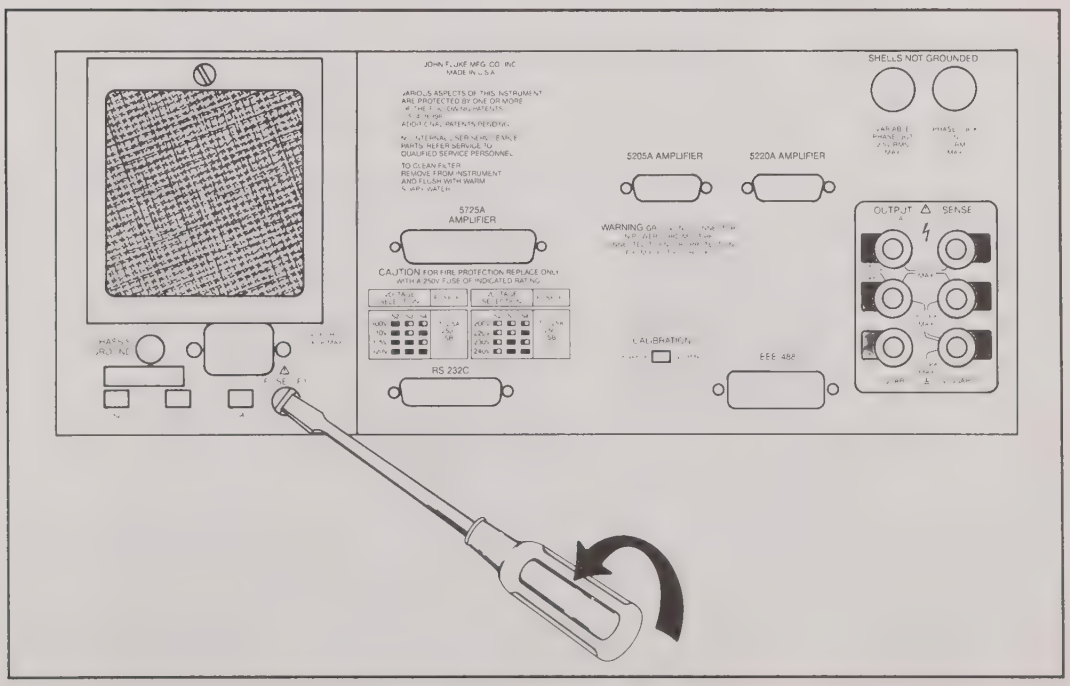


Figure 7-1. Accessing the Fuse

CLEANING THE AIR FILTER 7-3.

CAUTION

Damage caused by overheating may occur if the area around the fan is restricted, the intake air is too warm, or the air filter becomes clogged.

The air filter must be removed and cleaned every 30 days or more frequently if the calibrator is operated in a dusty environment. The air filter is accessible from the rear panel of the calibrator.

To clean the air filter, refer to Figure 7-2 and proceed as follows:

1. Remove the filter element.
   a. Unscrew the knurled screw at the top of the air filter (counterclockwise).
   b. Pull the air filter retainer downward; it hinges at the bottom.
   c. Remove the filter element.
2. Clean the filter element.
   a. Wash the filter element in soapy water.
   b. Rinse the filter element in fresh running water.
   c. Shake out the excess water, then allow the filter element to dry thoroughly before reinstalling it.
3. Reinstall the filter element, its retainer, and the knurled screw.

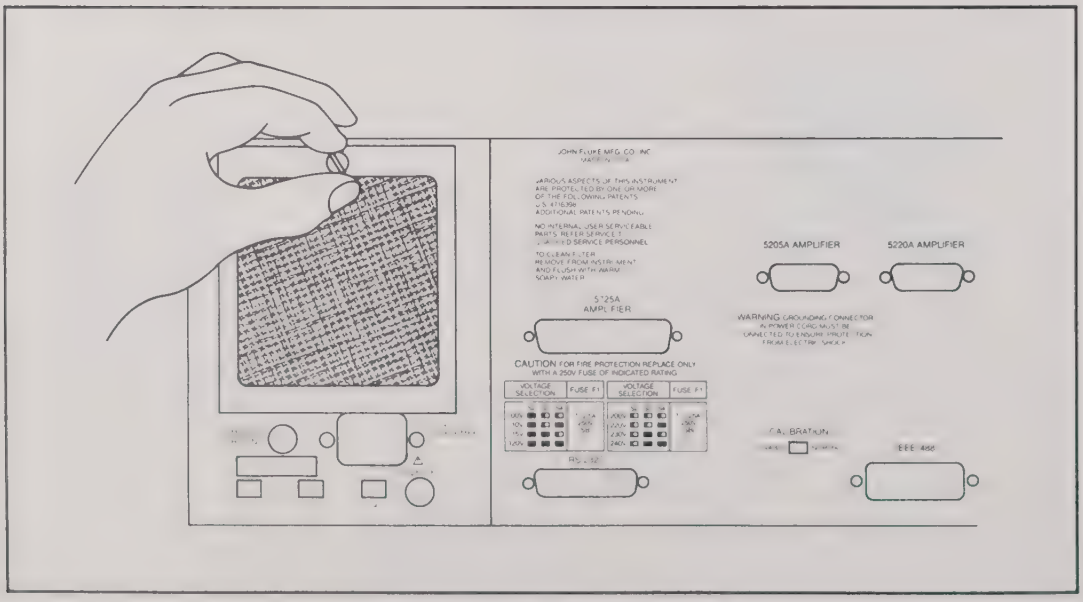


Figure 7-2. Accessing the Air Filter

GENERAL CLEANING 7-4.

To keep the 5700A looking like new, clean the case, front panel keys, and lens using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the calibrator.

CALIBRATION 7-5.

The following paragraphs cover the procedures for calibrating the 5700A to external standards, performing calibration check, and adjusting a range constant.

When shipped, your 5700A is calibrated at the factory, traceable to the U.S. National Bureau of Standards. All that is required to maintain traceability is calibration to external standards at the beginning of the calibration cycle and performance verification every two years. Calibration check and range calibration are optional procedures that are available accuracy for special needs.

Additional information about 5700A calibration is contained elsewhere in the manuals:

- Section 1 describes the calibration process and the theory behind its use to establish traceability to national standards. Included in Section 1 is a description of the calibration check feature, and how you can use it to develop a performance history for your 5700A.
- Section 2 of the Service Manual contains detailed calibration theory.
- Section 3 of the Service Manual contains a performance verification procedure recommended every two years to maintain traceability. Part of this is Wideband AC Module (Option 5700A-03) flatness calibration.

Calibrating the 5700A to External Standards 7-6.

Calibration to external standards is required at the beginning of the calibration cycle. The cycle is selected in a setup menu as described in Section 4 (24 hours, 90 days, 180 days, or 1 year). To calibrate the 5700A, you apply three portable standards to the OUTPUT binding posts: a 10V dc voltage standard, a 1Ω resistance standard, and a 10 kΩ resistance standard. The following standards are recommended:

- Model 732A DC Reference Standard
- Model 742A-1 1Ω Standard Resistor
- Model 742A-10k 10 kΩ Standard Resistor

You do not need to calibrate the 5700A in a tightly-controlled temperature environment. The recommended external standards and the 5700A have the ability to control or compensate for ambient temperature variations internally. During the procedure, the 5700A prompts you to input the ambient temperature. The 5700A retains this information for inclusion in specification readout and output shift reports.

When you finish calibration, but before you save the new constants, the 5700A presents you with the new changes as ± ppm and as a percentage of specification for each range and function. You can print a list of changes through the serial (RS-232-C) port, or send the changes to a computer through either the serial port or the instrument control (IEEE-488) port. The 5700A displays the largest proposed change on the front panel.

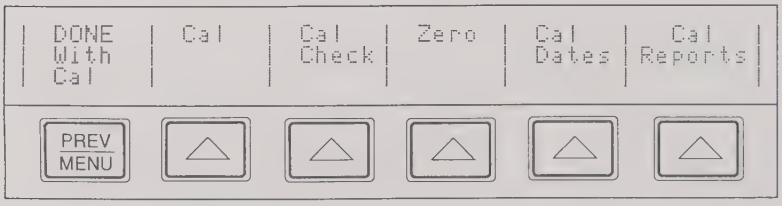
Table 7-1 lists the equipment required to calibrate the 5700A, excluding the optional wideband function, to external standards.

Table 7-1. Equipment Required to Calibrate the 5700A

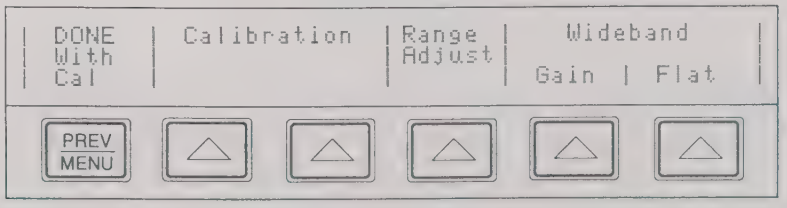
MODEL	DESCRIPTION
Fluke 732A	DC Voltage Reference Standard
Fluke 742A-1	1Ω Resistance Transfer Standard
Fluke 742A-10k	10 kΩ Resistance Transfer Standard
Fluke 5440A-7002	Low Thermal EMF Test Leads, 2 ft (61 cm)

Proceed from the power-up state as follows to calibrate the main output functions:

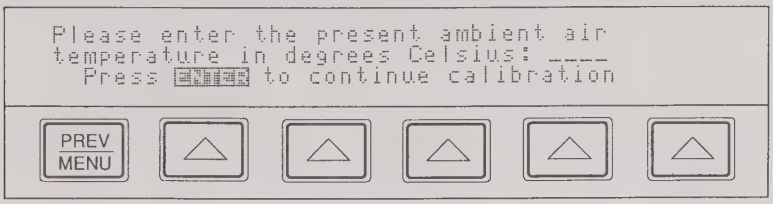
1. Turn on the 5700A and allow it to warm up for at least 30 minutes.
2. Press the "Setup Menus" softkey then the "Cal" softkey. The calibration menu appears:



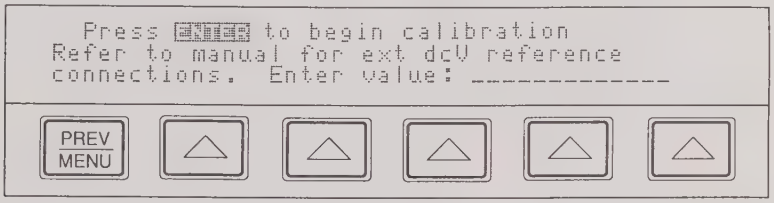
3. Press the "Cal" softkey. The display changes to:



4. To calibrate the main output functions, press one of the softkeys under the "Calibration" label. The display changes to:



5. Enter the ambient temperature, and press the ENTER key. The display changes to:



6. Connect the 732A to the 5700A as shown in Figure 7-3.

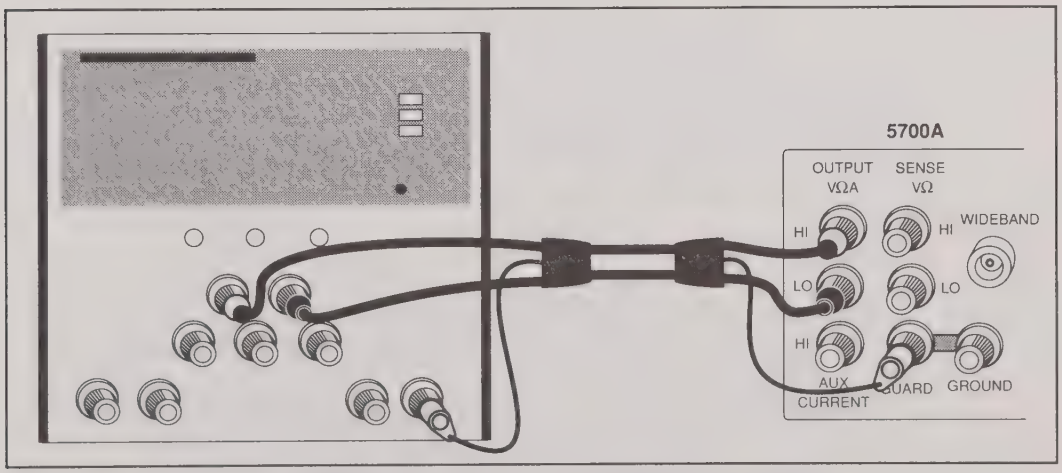
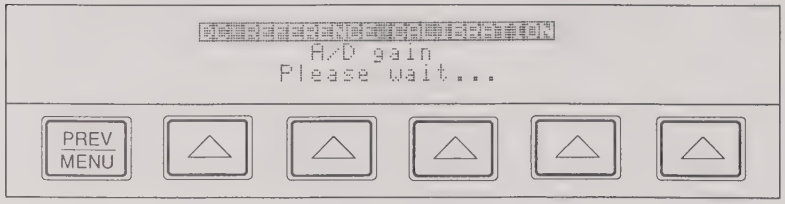


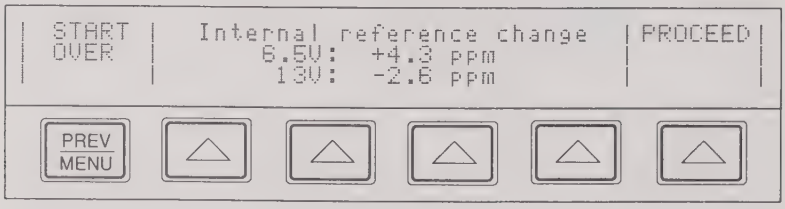
Figure 7-3. 732A External Calibration Connections

7. Enter the true value of the 732A 10V output. The true value is the value printed on the calibration sticker, plus or minus any drift since calibration. The 732A drifts in a very linear way, so you can interpolate the true value based on observed drift.

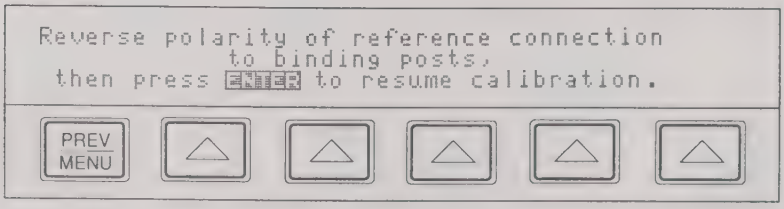
   If the entered value is not between 9 and 11V, an error message appears which allows you to start again from this point with a calibrated 732A. After you press the ENTER key, the display changes to:



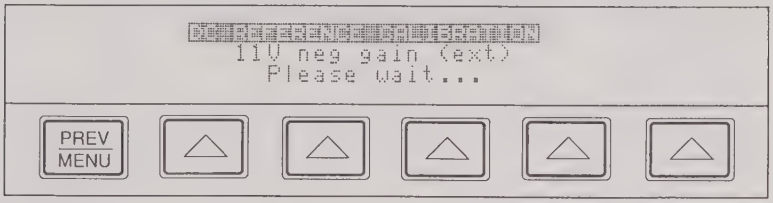
   When the 5700A 6.5V and 13V references have been characterized, the following message appears, allowing you to accept or reject the changes about to be made to the calibration constants:



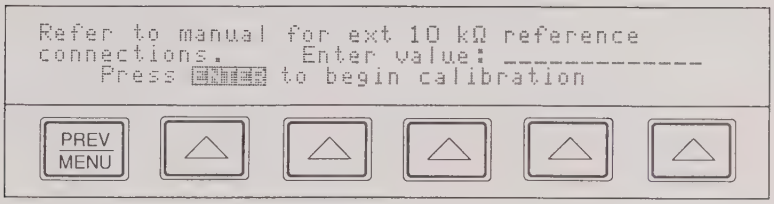
8. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with the following message on the display:



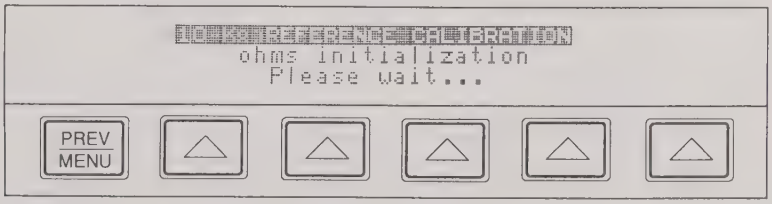
9. Reverse the HI and LO connections at the 732A terminals, and press ENTER. The display changes to:



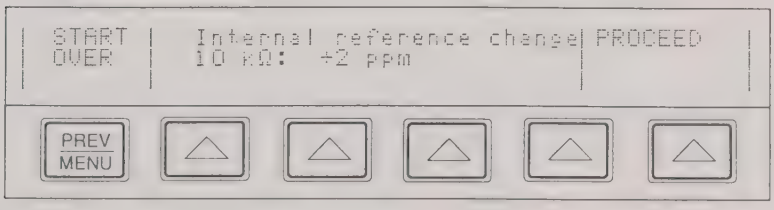
10. When the display changes to:



Connect the 5700A to the 10 kΩ standard as shown in Figure 7-4 and enter the true value of the standard. If the standard is not between 9 kΩ and 11 kΩ, an error message appears, which allows you to start again from this point with another standard. When you press the ENTER key, the display changes to:



When the internal 10 kΩ reference has been characterized, the following message appears, allowing you to accept or reject the changes about to be made to the calibration constant:



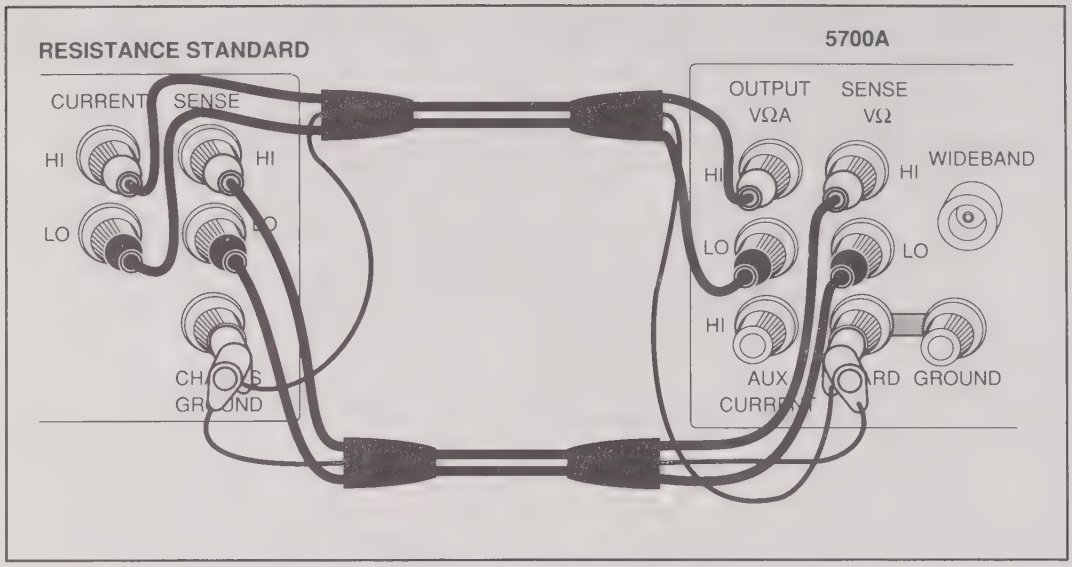
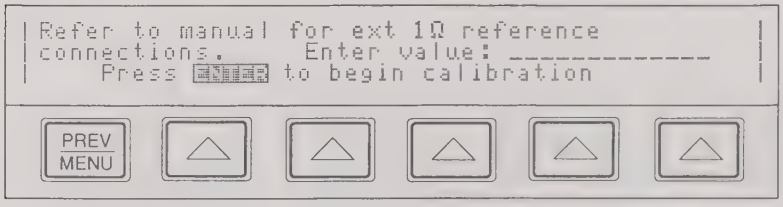


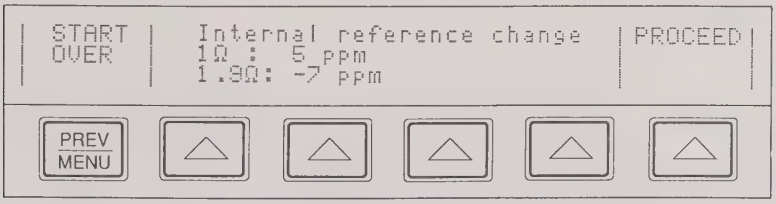
Figure 7-4. 742A-1 and 742A-10k External Calibration Connections

11. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with the following message on the display:



12. Disconnect the 10 kΩ standard, and connect the 5700A to the 1Ω standard the same way, then enter the true value of the 1Ω standard. If the standard is not between 0.9Ω and 1.1Ω, an error message appears which allows you to start again from this point with another standard. When you press the ENTER key, the display changes to:

When the internal 1Ω reference has been characterized, the following message appears allowing you to accept or reject the changes about to be made to the calibration constant:



13. If you press PREV MENU, control reverts to the menu in step 3. If you press the "PROCEED" softkey, the 5700A saves the settings in temporary memory for future storage in nonvolatile memory. Calibration continues with internal-only calibration steps.

14. Calibration is not effective until you store the newly-calculated constants in memory. To store the constants, set the rear panel CALIBRATION switch to ENABLE, then press the "Store Values" softkey.

NOTE

You can print a listing of the proposed output shifts to review them before storing the new constants. To print the listing, press the "Print Output Shifts" softkey.

15. After you store the constants, press the "DONE with cal" softkey to exit the calibration menu and resume normal operation. If you press this softkey before storing the constants, the process is aborted without updating existing calibration constants.

16. Set the rear panel CALIBRATION switch to NORMAL.

Wideband AC Module (Option 5700A-03) Calibration 7-7.

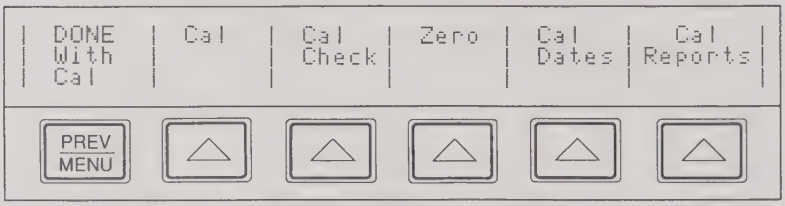
The Wideband AC Module (Option 5700A-03) requires two kinds of calibration: gain and flatness. Gain should be calibrated at the same time as routine calibration of the 5700A main output functions.

Because frequency flatness is determined by such stable parameters as circuit geometry and dielectric constants, flatness of the Wideband AC module has excellent long-term stability. This stability gives the Wideband AC Module a two-year calibration cycle for flatness calibration. Flatness calibration is required only infrequently, and can be done when the 5700A is returned to a standards laboratory for periodic verification. The 5700A Service Manual contains the wideband flatness calibration procedure. Presented here is the wideband gain calibration procedure.

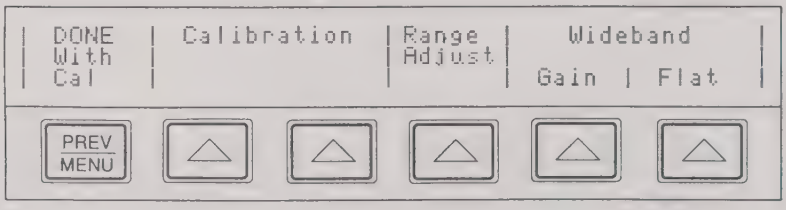
For wideband gain calibration, the only required equipment other than that supplied as standard equipment with the wideband option is a Type "N" female to double banana plug adapter (e.g., Pomona 1740). Proceed as follows to calibrate wideband gain:

1. Verify that the 5700A has warmed up for at least 30 minutes.

2. Press the "Setup Menus" softkey then the "Cal" softkey. The calibration menu appears:



3. Press the "Cal" softkey. The calibration menu appears:



4. Connect the wideband output cable between the WIDEBAND connector and the SENSE binding posts with the center conductor of the 50Ω feedthrough going to SENSE HI as Figure 7-5 shows. The GND tab on the adapter should be on the LO side.

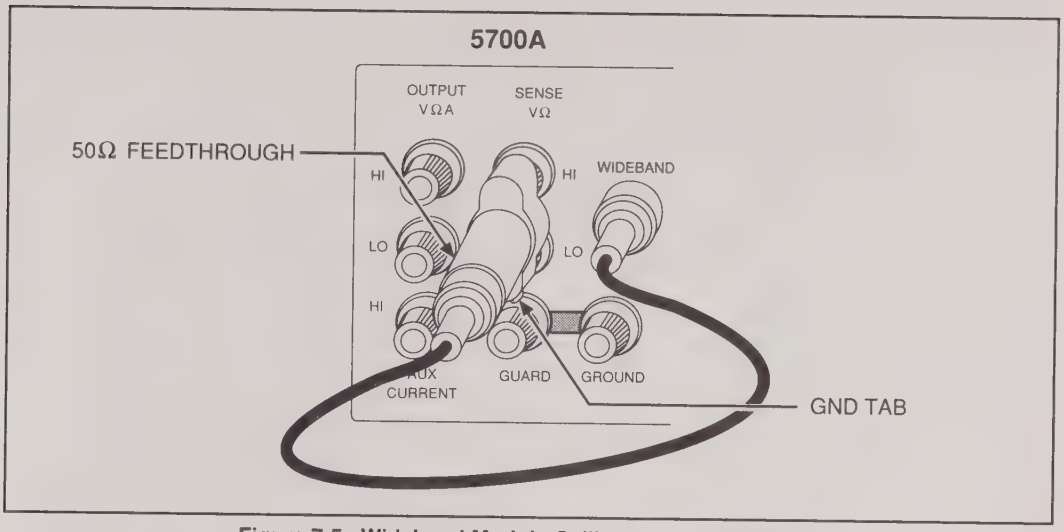
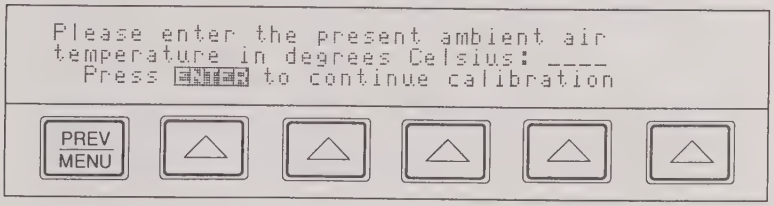
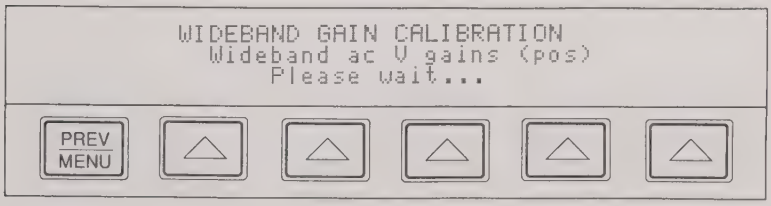


Figure 7-5. Wideband Module Calibration Connection

5. Press the "Gain" softkey. The display changes to:

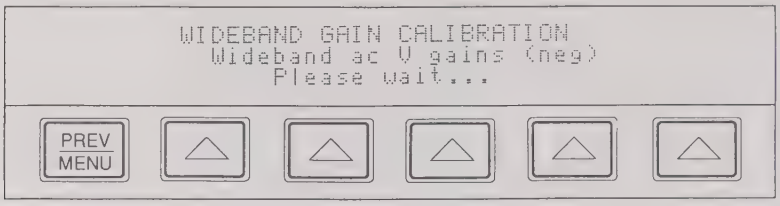


6. Enter the ambient temperature, and press [ENTER]. The display changes to:



As wideband gain calibration proceeds, messages appear on the display identifying all processes as they are encountered. When positive gains calibration is complete, a message appears telling you to refer to the manual for negative gains connections.

7. Reverse the dual-banana connector so that the center conductor is connected to LO and press ENTER. The display changes to:



After a brief time, a message announces that wideband gains calibration is complete.

8. To store the new constants, set the CALIBRATION switch to ENABLE and press "Store values". If you do not wish to make wideband gains calibration effective, press "DONE with cal" and answer "YES" to the next display that asks for verification.

9. Calibration is finished. Set the CALIBRATION switch to NORMAL, disconnect the wideband cable, and press RESET.

Doing a Calibration Check 7-8.

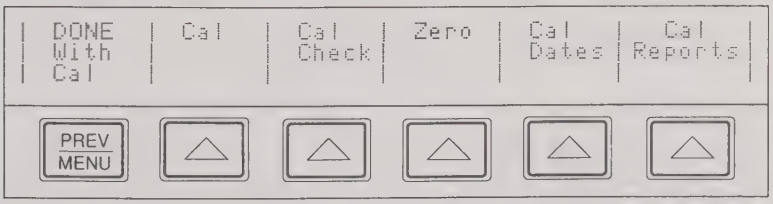
Calibration check is similar to calibration except that no changes are made to stored constants, and the internal check standards are used as the reference points. Calibration check produces a report similar to normal calibration, showing proposed changes. Because calibration check does not change stored calibration constants, there is no need to enable the rear panel CALIBRATION switch. The procedure can be done by an external computer, completely unattended. (See Section 5 for a calibration check remote program example.)

You can use calibration check at any time to confirm the integrity of the 5700A's state of calibration without having to connect external standards. You can also use calibration check as a powerful performance history gathering tool.

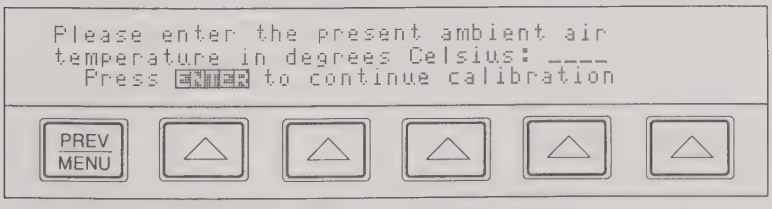
Proceed from the power-up state as follows to do a calibration check:

1. Turn on the 5700A, and allow it to warm up for at least 30 minutes.

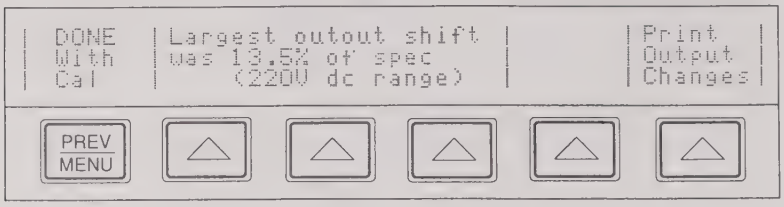
2. Press the "Setup Menus" softkey, then press the "Cal" softkey. The calibration menu appears:



3. Press the "Cal Check" softkey. The display changes to:



4. Enter the ambient temperature and press [ENTER]. As calibration check proceeds, messages appear on the display identifying all processes as they are encountered. When the whole process is complete, the display shows the largest shift detected:



5. At this point you can print a listing of the proposed shifts or you can quit. To return to normal operation, press the "DONE with check" softkey.

   To print a calibration check report, connect a printer or other peripheral and set up the serial interface as described in Section 6. Press the "Print Output Changes" softkey.

6. Press [PREV MENU] to exit the calibration menu.

Range Calibration 7-9.

After calibration, you can make further fine adjustments to each range if you wish by adjusting a range constant. This is called Range Calibration. A range constant is an additional gain multiplier for each range. Range adjustments are optional; they are not necessary to meet total uncertainty specifications. However, they do allow you to align the 5700A closer to your standards.

To adjust a range constant, you use your own laboratory standard. This procedure is designed to work for laboratory standard values that are greater than or equal to 45% of the range full-scale value and less than or equal to 95% of the range full-scale value. The new range constant is active until the next calibration event. Every time you calibrate the 5700A, all range constant multipliers are reset to 1. You can also erase all range adjustments by calling up the format EEPROM menu and selecting range constants. (See page 4-7.)

The procedure to adjust a range constant is menu driven, similar to normal calibration. Many different types of standards in many different configurations can be used for the different functions and ranges. For example, you can adjust the 220V dc range using the following equipment:

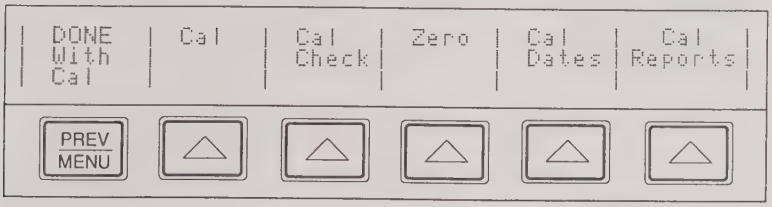
- 732A DC Reference Standard
- 752A Reference Divider
- 845AB/845AR Null Detector
- 5440B-7002 Low Thermal Test Leads (three sets)

A procedure to adjust the 220V dc range constant using the above equipment is described here. You can use your own laboratory standards to adjust other range constants similarly.

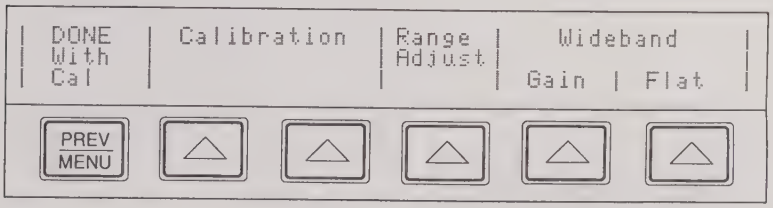
Proceed as follows to adjust the 220V dc range constant:

1. Perform calibration to external standards as described previously in this section.

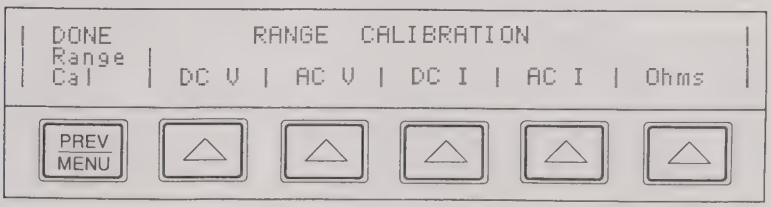
2. Press the "Setup Menus" softkey, then press the "Cal" softkey. The calibration menu appears:



3. Press the "Cal" softkey. The display changes to:

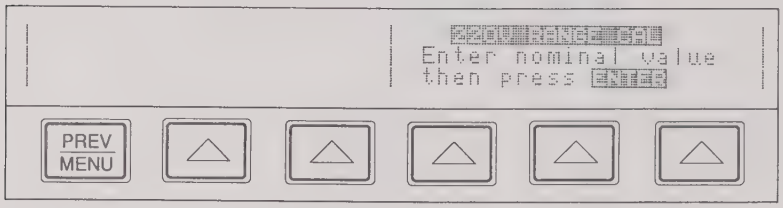


4. Press the "Range Adjust" softkey. The display changes to:



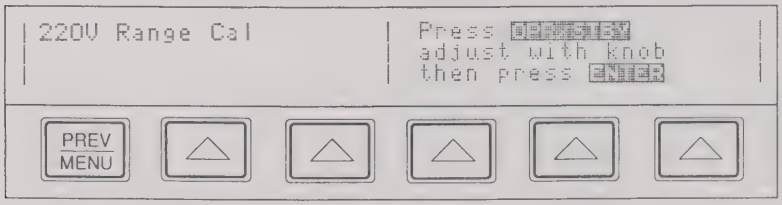
5. Press the "DC V" softkey. The display changes to:

6. All the ranges for dc voltage are presented in a series of menus. Pressing the "NEXT Menu" softkey scrolls through the choices. Press "NEXT Menu" until "220 V" appears, then press its softkey.



7. Connect the 732A, 845A, and 732A in a 10:1 configuration as Figure 7-6 shows.

8. Enter the value of the 732A multiplied by 10. (This is the output of the 752A to which you will null the output of the 5700A.) When you press [ENTER], the display changes to:



9. Press [OFFSET] to activate the calibrator output.

10. Rotate the 5700A output adjustment knob to achieve a null on the 845A Null Detector.

11. Set the rear panel CALIBRATION switch to ENABLE.

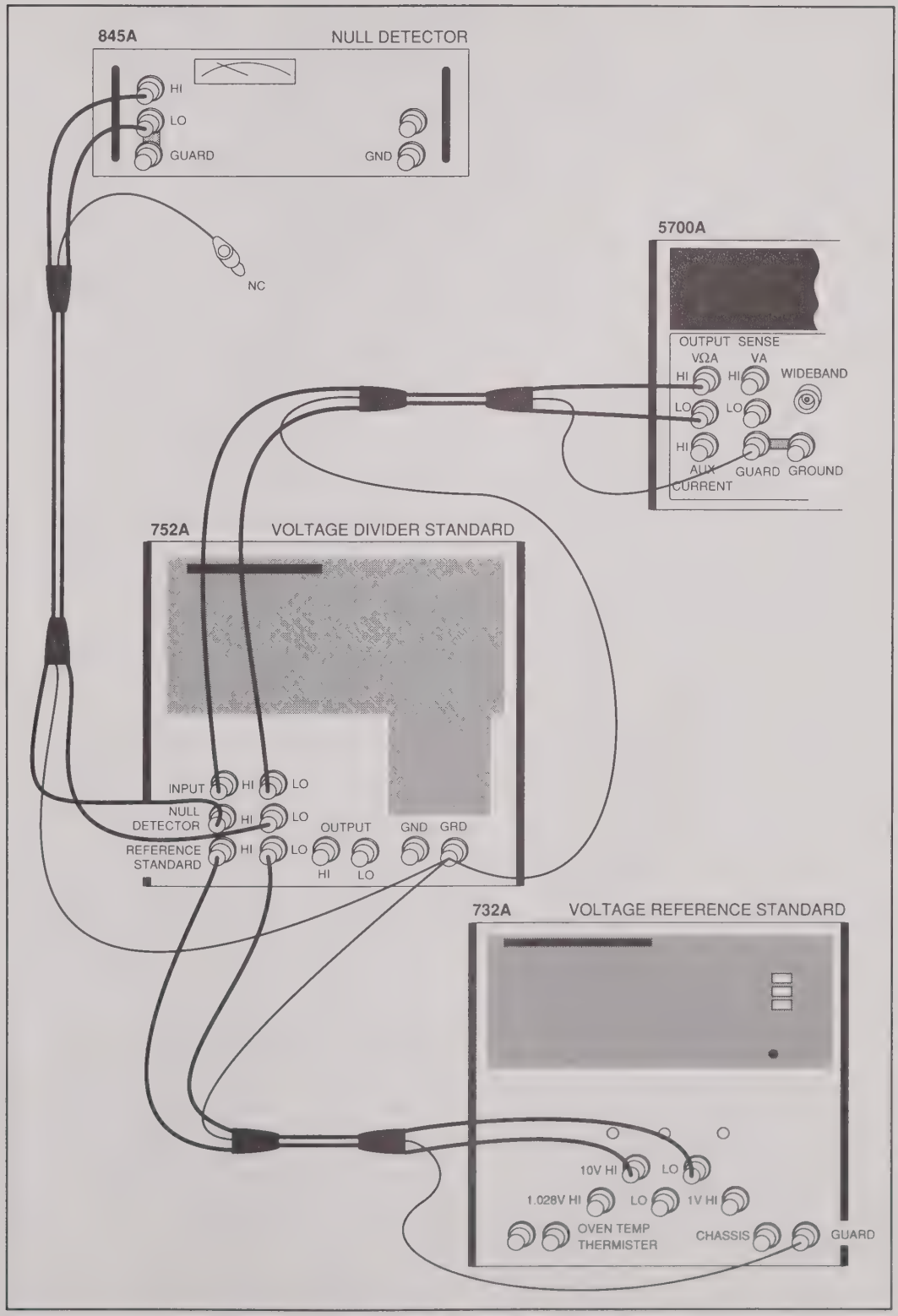


Figure 7-6. 220V DC Range Calibration Connections

12. Press [ENTER]. This causes the 5700A to calculate a new range constant multiplier for the 220V dc range and store it in nonvolatile memory.

13. Range calibration is complete. Set the rear panel CALIBRATION switch to NORMAL, disconnect the external standards, and press [RESET].

Section 8
Options and Accessories

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INTRODUCTION 8-1.

This section describes options and accessories available to enhance the capabilities of the 5700A Calibrator. Section 4 contains instructions for operating the 5700A with the options and accessories described here. To order options or accessories, call or write to a Fluke Sales and Service Center. (A List of Technical Service Centers is located in Appendix D of this manual.)

WIDEBAND AC VOLTAGE MODULE (OPTION 5700A-03) 8-2.

The Wideband AC Voltage Module (Option 5700A-03) is a high-accuracy, low-noise, extremely flat ac voltage source with a frequency range of 10 Hz to 30 MHz. With the wideband module, the 5700A can calibrate rf voltmeters. Output is in seven ranges from 300 μV (-57 dBm) to 3.5V (+24 dBm) through a coaxial connector into a 50Ω load. Output level is selected in volts or dBm through either the front panel controls or under remote control.

The wideband module also functions with the 5700A edit controls, allowing you to display the error of a wideband meter in percentage of output or decibels.

Included with the wideband module are a Type "N" output cable and a 50Ω terminator. The wideband module is calibrated to the end of its standard-equipment output cable.

ACCESSORIES 8-3.

Table 8-1 summarizes the accessories available for the 5700A Calibrator. Following the table is a brief description of each accessory.

Table 8-1. Accessories

MODEL	DESCRIPTION
732A	DC Voltage Reference Standard
742A-1	1Ω Resistance Transfer Standard
742A-10k	10 kΩ Resistance Transfer Standard
5440A-7002	Low Thermal EMF Test Leads, 2 ft (61 cm)
Y5737	24 in. (61 cm) Rack Mount Kit for 5700A
Y5735	24 in. (61 cm) Rack Mount Kit for 5725A
Y1702	RS-232-C Null-Modem Cable, 6.56 ft (2m)
Y1703	RS-232-C Null-Modem Cable, 13 ft (4m)
Y5701	5205A or 5215A Interface Cable
Y5702	5220A Interface Cable

Low Thermal EMF Test Leads (5440A-7002) 8-4.

Model 5440A-7002 Low Thermal Test Leads are designed to exhibit low thermal emfs. The set includes two conductors and a shield lead.

Rack Mount Kits (Y5737 and Y5735) 8-5.

The rack mount kits provide all the hardware necessary to mount the 5700A and the 5725A Amplifier on slides in a 24-inch (61 cm) equipment rack. Model Y5737 is for the 5700A and Model Y5735 is for the 5725A. Instructions are provided in Section 2 and are also included with each kit.

Shielded IEEE-488 Interface Cables (Y8021, Y8022, and Y8023) 8-6.

Shielded IEEE-488 cables are available in three lengths (see Table 8-1). The cables attach the 5700A to any other IEEE-488 device. Each cable has double 24-pin connectors at both ends to allow stacking. Metric threaded mounting screws are provided with each connector. Figure 5-2 in Section 5 shows the pinout for the IEEE-488 connector.

RS-232-C Null-Modem Cables (Y1702 and Y1703) 8-7.

The Y1702 (6.56 ft, 2m) and Y1703 (32.8 ft, 10m) RS-232-C Null-Modem Cables connect the 5700A to a printer, video-display terminal, computer, or other serial device configured as DTE (Data Terminal Equipment). These cables are wired with the correct signal line inversions and two female 25-pin subminiature D connectors as necessary to connect two DTE units together. Figure 6-1 in Section 6 shows the pinout for the rear-panel serial interface connector.

Section 6 contains instructions for transferring serial data from the 5700A. Section 5 contains instructions for operating the 5700A remotely control via the serial interface.

5205A or 5215A Interface Cable (Y5701) 8-8.

The 5205A or 5215A interface cable connects between the 5700A and the 5205A or 5215A Precision Power Amplifier, providing the necessary digital and analog interface.

5220A Interface Cable (Y5702) 8-9.

The 5220A interface cable connects between the 5700A and the 5220A Transconductance Amplifier, providing the necessary digital and analog interface.

DC Voltage Reference Standard (732A) 8-10.

The Fluke 732A is a rugged, easily transported solid state direct voltage reference standard with a highly predictable 10V output. This predictability allows the Fluke Standards Laboratory, as well as many Fluke customers, to completely eliminate fragile, saturated standard cells. Many laboratories that maintain standard cells use the 732A as a transportable voltage standard, eliminating the need to transport their standard cells. The 732A can be short circuited, even for extended periods of time, without damage or loss of stability. The 732A maintains full specified stability over a temperature span of 18 to 28°C.

The 5700A uses a 10V reference standard such as the Fluke 732A in an automated menu-prompted procedure to establish voltage traceability. Section 7 describes this procedure.

1Ω and 10 kΩ Standard Resistors (742A-1 and 742A-10k) 8-11.

The 5700A uses 1Ω and 10 kΩ resistor standards such as the 742A Series in its semi-automated calibration procedure to establish external traceability of resistance and current. Section 7 describes this procedure.

The 742A Resistance Standards, which are constructed of arrays of Fluke wirewound precision resistors, are ideally suited as support standards for the 5700A. Stability of the resistance transfer standards and their temperature coefficients make them ideal for easy transport to and operation in the calibrator's working environment.

AUXILIARY AMPLIFIERS 8-12.

Four amplifiers are available to extend the high voltage performance and current range of the 5700A:

- Fluke Model 5725A Amplifier
- Fluke Model 5205A Precision Power Amplifier
- Fluke Model 5215A Precision Power Amplifier
- Fluke Model 5220A Transconductance Amplifier

Interface connectors on the 5700A rear panel accept cables to directly operate a 5725A, a 5220A, and either a 5205A or 5215A. Three amplifiers can be connected to the 5700A at the same time, but only one output can be active at a time. Once you have connected the amplifiers and configured the 5700A in a setup menu, amplifier operation is controlled by the 5700A.

Section 4 provides instructions for operating each amplifier. The general specifications at the end of Section 1 include specifications for operating the 5700A with the 5725A. For other amplifier specifications, refer to their instruction manuals. Table 1-1 summarizes the extended capabilities offered by each amplifier. Brief descriptions of the extended capabilities follow.

5725A Amplifier 8-13.

The Fluke 5725A Amplifier is an external unit operating under 5700A control to extend ac voltage drive capabilities and both ac and dc current output range. The amplifier adds the following capabilities to the 5700A 1100V ac range with no compromise in accuracy:

- Frequency limits at higher voltage increase to 100 kHz at 750V, 30 kHz at 1100V.
- Load limit increases to 70 mA for frequencies above 5 kHz.
- Capacitive drive increases to 1000 pF, subject to the maximum output current.

Extended-performance voltage is available at the 5700A front or rear binding posts, eliminating the need to change cables during a procedure.

A separate set of binding posts on the front panel of the 5725A supplies extended-range ac and dc current outputs. Since most meters have a separate input terminal for the high current ranges, this eliminates the need to change cables during a procedure. A 5700A/5725A cluster can also be configured to source all current (both standard 5700A-generated outputs and its own outputs) through the 5725A binding posts.

5205A and 5215A Precision Power Amplifiers 8-14.

The Fluke 5205A and 5215A Precision Power Amplifiers extend 5700A high voltage load and frequency capabilities for demanding applications. A 5205A or 5215A adds the following capabilities to the 5700A 1100V ac voltage range with accuracy sensing at the load point:

- Frequency limit at higher voltage increases to 100 kHz at 1100V.
- Resistive load limit increases to 200 mA.
- Capacitive load limit increases to 1500 pF.

In addition, a 5205A increases 5700A 1100V dc load limits to 70 mA and 1500 pF.

A 5205A or 5215A allows the 5700A to reach higher volt-Hertz products occasionally called for, and to maintain high accuracy with heavy loads and long cables.

5220A Transconductance Amplifier 8-15.

The Fluke 5220A Transconductance Amplifier extends the ac and dc current capability of the 5700A to 20A. This high-current output lets you calibrate current meters and shunts, as well as the high-current functions of DMMs and VOMs. High compliance voltage means the 5220A can sustain full output current through multi-turn fixtures for calibrating current transformer and Hall-effect probes.

Appendices

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Appendix A
Fault Codes

100 LEVEL FAULTS: AIR FLOW MONITORING SUBSYSTEM	
100	Low Air Flow
200 LEVEL FAULTS: 5725 BOOST SYSTEM	
200	5725 No Error
201	5725 Self-Test ROM Failure
202	5725 Self-Test RAM Failure
203	5725 Self-Test EAROM Failure
204	5725 Self-Test Data Bus Failure
205	5725 Self-Test CLAMPS Circuit Failure
206	5725 Self-Test HVCLR Circuit Failure
207	5725 Self-Test DAC Failure
208	5725 Self-Test Watchdog Timer Failure
219	5725 Current Heatsink Too Hot
220	5725 Current Compliance Voltage Too High
221	5725 +400V Supply Did Not Shut Off
222	5725 -400V Supply Did Not Shut Off
223	5725 Voltage Heatsink Too Hot
224	5725 +400V Supply Too Low
225	5725 +400V Supply Too High
226	5725 -400V Supply Too Negative
227	5725 -400V Supply Too Positive
228	5725 +400V Supply Current Too High
229	5725 -400V Supply Current Too High
280	5725 CLAMPS Fault
281	5725 Software TRAP
282	5725 Cable Was Off
283	5725 RESET (power-up or watchdog timer)
284	5725 Guard-Crossing Timeout
285	5725 Illegal/Unexecutable Command
286	5725 Non-Maskable Interrupt Occurred
287	5725 HVCLEAR Circuit Activated
400 LEVEL FAULTS: CALIBRATION CONSTANT SUBSYSTEM	
400	Bad Cal Constant ID

500 LEVEL FAULTS: CONFIGURATION FINDER SUBSYSTEM	
500	Bad Mode To CNFmodeRanges
501	Configuration Table Overflow
502	Bad Amplifier Type Selection
503	Bad Flat Constant Type Selection
504	Bad Flat Constant Type In Table
505	5725 Guard Crossing Wouldn't Start

600 LEVEL FAULTS: DOT MATRIX DISPLAY DRIVER SUBSYSTEM	
600	Bad Row Selector
601	Bad Column Argument
602	Bad Character

700 LEVEL FAULTS: ERROR HANDLING SUBSYSTEM	
700	Error Queue Overflow
701	Bad ERR Channnel

800 LEVEL FAULTS: EXECUTIVE SUBSYSTEM	
800	Wideband Module Needed
801	External Amplifier Not Connected
802	Amplifier Must Remain On For This Output
803	Over Limits Of Locked Range
804	Under Limits Of Locked Range
806	Invalid Date
807	Invalid Time
808	DC dBm Not Allowed
809	Ext Ref Value Out Of Range
810	Bad Edit Digit Movement
811	Not Wideband Units
812	Can't Set Frequency With Ohms
813	Bad Units
814	Wrong Polarity For Limit
815	Outside Entry Limits
816	Magnitude Too Large For Calibrator
817	Magnitude Too Small For Calibrator
818	Frequency Too Large For Calibrator
819	Frequency Too Small For Calibrator
820	Calibrator Can't Source That Value
821	V Limit Outside Calibrator Ability
822	I Limit Outside Calibrator Ability
823	Can't Adjust Frequency To $\leqq$ 0 Hz
824	Offset Not Allowed Now
825	Scale Not Allowed Now
826	Ohms Reading Set Too High
827	Ohms Reading Set Too Low
828	Can't External Sense This Range
829	Can't Phase Shift This Range
830	Can't Phase Lock This Range
831	Can't 2 Wire Comp This Range

832	Couldn't Do De Wideband Output
833	Bad Selector For Set/Get Item
834	Can't Boost This Output Mode
835	Can't Use Ext Sense On This Range
836	Can't Use 2 Wire Comp On This Range
837	Can't Lock This Range
838	Can't Set Clock, Rear Switch In NORMAL
839	Can't Fmt EEPROM, Rear Switch In NORMAL
840	Illegal Output Post For Current
841	No 5725 Available For Selected Output
842	Not A Valid Wideband Flatness Point
843	Wideband Flatness Cal Is Not Active
844	Report String Too Long
845	Can't Store, Rear Switch In NORMAL
846	Range Calibration Is Not Active
847	Magnitude Too High For Range Cal
848	Magnitude Too Low For Range Cal
849	Invalid Calibrator Setup Block
850	Can't Store, 5725 Switch In NORMAL
851	Can't Format, 5725 Switch In NORMAL
900 LEVEL FAULTS: KEYBOARD DRIVER SUBSYSTEM	
900	Keyboard Output Queue Full
1000 LEVEL FAULTS: 5725 COMMUNICATION RECEIVE SUBSYSTEM	
1000	Couldn't ACK Packet From 5725
1001	Illegal 5725 Receive Task State
1002	Bad Receive Packet Number From 5725
1003	Bad Control Byte From 5725
1100 LEVEL FAULTS: 5725 COMMUNICATION TRANSMIT SUBSYSTEM	
1100	Multiple Timeouts Sending To 5725
1101	5725 Request Reset Loop
1102	Unexpected NSA From 5725
1103	Bad Packet Number In ACK From 5725
1104	Bad Control Byte From 5725 Receive Task
1105	Illegal 5725 Transmit Task State
1200 LEVEL FAULTS: 5725 COMMUNICATION UTILITY SUBSYSTEM	
1200	Serial Write Failure To 5725
1300 LEVEL FAULTS: OUTPUT MONITOR SUBSYSTEM	
1300	Undefined Signal
1301	Output Tripped To Standby
1302	Output Tripped To Standby
1400 LEVEL FAULTS: SOFTWARE TIMER SUBSYSTEM	
1400	Can't Install MTtick()
1401	Bad Timer Selector

1500 LEVEL FAULTS: GUARD CROSSING RECEIVE SUBSYSTEM	
1500	Couldn't ACK Packet From Inguard
1501	Illegal Inguard Receive Task State
1502	Bad Receive Packet Number From Inguard
1503	Bad Control Byte From Inguard

1600 LEVEL FAULTS: GUARD CROSSING TRANSMIT SUBSYSTEM	
1600	Multiple Timeouts Sending To Inguard
1601	Inguard Request Reset Loop
1602	Unexpected NSA From Inguard
1603	Bad Packet Number In ACK From Inguard
1604	Bad Control Byte From Inguard Rcv Task
1605	Illegal Inguard Transmit Task State

1700 LEVEL FAULTS: GUARD CROSSING UTILITY SUBSYSTEM	
1700	Serial Write Failure To Inguard

1800 LEVEL FAULTS: NORMAL OUTPUT OPERATIONS SUBSYSTEM	
1800	DORMANT To OPERATE
1801	Bad Transition Type
1802	Bad Boolean Selector
1803	NRMrngStby Encountered Error
1804	DCV Called For Non-DCV Range
1805	ACV Called For Non-ACV Range
1806	Bad ACV Frequency Range
1807	Hi Res Frequency Too High
1808	ACV Amplitude Correction Failure
1809	Can't Phase Lock To Signal
1810	Bad Phase Quadrant
1811	Current Called for Non-Current Range
1812	Ohms Called for Non-Ohms Range
1813	Can't Phase Lock, Output Not AC
1814	Can't Phase Shift, Output Not AC
1815	Bad Wide Band Range
1816	Freq. Too High Even For Wide Band
1817	Illegal Current Output Location
1818	Output Current Out Of Tolerance
1819	Current Compliance Voltage Exceeded
1820	2 Wire Ohms Compensation Current Exceeded
1821	NRMbstcur Passed Bad Range
1822	5220 No Longer Connected
1823	5220 Detected And Shut Off
1824	5205 No Longer Connected
1825	5205 Detected And Shut Off
1826	5725 No Longer Connected
1827	14 Bit DAC Scaling Found Zero Output

1900 LEVEL FAULTS: NON-VOLATILE SUBSYSTEM	
1900	Couldn't Write Byte To EEPROM
1901	Checksum Error Reading EEPROM
1902	EEPROM Is Full
1903	Unknown Nonvolatile Constant Selector
1904	EEPROM Partition Is Full
2000 LEVEL FAULTS: ANALOG OPERATIONS MANAGER SUBSYSTEM	
2000	Bad Command Code
2001	Bad Signal
2002	Long Term Command In Progress
2003	Guard Crossing Protocol Failed To Start
2004	Fatal Fault, Output Tripped
2100 LEVEL FAULTS: OUTPUT DISPLAY DRIVER SUBSYSTEM	
2100	Bad Display Selector
2101	Bad Character
2102	Bad Annunciator Selector
2200 LEVEL FAULTS: REMOTE INTERFACE SUBSYSTEM	
2200	Unknown Command
2201	Invalid Number Of Parameters
2202	Invalid Cal Constant Name
2203	Invalid Keyword
2204	Invalid Range
2205	Invalid Parameter Type
2206	Invalid Parameter Unit
2207	Invalid Parameter Value
2208	IEEE488.2 I/O DEADLOCK
2209	Hardware Not Ready Yet
2210	IEEE488.2 INTERRUPTED Query
2211	Not Allowed From GPIB Interface
2212	Not Allowed From Serial Interface
2213	Remote Only
2214	Syntax
2215	IEEE488.2 UNTERMINATED Command
2216	Symbol Table Overflow
2217	Command Reserved For Service
2300 LEVEL FAULTS: EXECUTIVE SUBSYSTEM	
2300	Unknown Report Requested
2301	Unknown Report Device Requested
2400 LEVEL FAULTS: REAL TIME CLOCK SUBSYSTEM	
2400	Can't Install Interrupt Handler
2401	Unknown Interrupt Selector
2402	Bad Date & Can't Be Set

2500 LEVEL FAULTS: SELF CALIBRATION SUBSYSTEM

2500	Invalid Cal Procedure Number
2501	Couldn't Ext Cal Gain
2502	Couldn't Ext Cal Ref
2503	Couldn't Ext Cal Neg
2504	Couldn't Cal Ratio
2505	Couldn't Cal Pos 11V or 22V DC Zero
2506	Couldn't Cal Neg 11V or 22V DC Zero
2507	Couldn't Cal Pos 11V or 22V DC Gain
2508	Couldn't Cal 6.5V or 13V Buf Ref
2509	Couldn't Cal 2.2V Zero
2510	Couldn't Cal 220mV Gain S1
2511	Couldn't Cal 220mV Gain S2
2512	Couldn't Cal 220mV Gain S3
2513	Couldn't Cal 220mV Gain S4
2514	Couldn't Cal 220V DC Offset
2515	Couldn't Cal 220V DC Rnet
2516	Couldn't Cal 220V DC Gain
2517	Couldn't Çal ACV Gain
2518	Flatness Cal: Main Sensor Fail?
2519	Flatness Cal: AC Cal Sensor Fail?
2520	Couldn't Cal Fine Tune (14 bit) DAC
2521	Couldn't Cal Fine Tune 15th bit Down
2522	Couldn't Cal Fine Tune 15th bit Up
2523	Couldn't Cal 2.2mV/22mV step 1
2524	Couldn't Cal 2.2mV/22mV step 2
2525	Couldn't Cal 220V AC Offset
2526	Couldn't Cal 220V AC Gain
2527	Couldn't Cal 220mV Offset
2528	Couldn't Cal 1100V AC/DC Offset
2529	Couldn't Cal 1100V AC/DC Gain
2530	Couldn't Cal 220μuA DC Zero
2531	Couldn't Cal 2.2mA DC Zero
2532	Couldn't Cal 22mA DC Zero
2533	Couldn't Cal 220mA DC Zero
2534	Couldn't Cal 2.2A DC Zero
2535	Couldn't Cal 220μA DCI (Meas 1)
2536	Couldn't Cal 220μA DCI (Meas 2)
2537	Couldn't Cal 2.2mA DCI (Meas 1)
2538	Couldn't Cal 2.2mA DCI (Meas 2)
2539	Couldn't Cal 22mA DCI (Meas 1)
2540	Couldn't Cal 22mA DCI (Meas 2)
2541	Couldn't Cal 220mA DCI (Meas 1)
2542	Couldn't Cal 220mA DCI (Meas 2)
2543	Couldn't Cal 2.2A DCI (Meas 1)
2544	Couldn't Cal 2.2A DCI (Meas 2)
2545	Couldn't Ext Cal 10K Ohm Std (Meas 1)
2546	Couldn't Ext Cal 10K Ohm Std (Meas 2)
2547	Couldn't Ext Cal 10K Ohm Std (Meas 3)
2548	Couldn't Cal 10K Ohm (Meas 1)
2549	Couldn't Cal 10K Ohm (Meas 2)
2550	Couldn't Cal 10K Ohm (Meas 3)

2551	Couldn't Cal 19K Ohm (Meas 1)
2552	Couldn't Cal 19K Ohm (Meas 2)
2553	Couldn't Cal 19K Ohm (Meas 3)
2554	Couldn't Cal 100K Ohm (Meas 1)
2555	Couldn't Cal 100K Ohm (Meas 2)
2556	Couldn't Cal 190K Ohm (Meas 1)
2557	Couldn't Cal 190K Ohm (Meas 2)
2558	Couldn't Cal 1M Ohm (Meas 1)
2559	Couldn't Cal 1M Ohm (Meas 2)
2560	Couldn't Cal 1.9M Ohm (Meas 1)
2561	Couldn't Cal 1.9M Ohm (Meas 2)
2562	Couldn't Cal 10M Ohm (Meas 1)
2563	Couldn't Cal 10M Ohm (Meas 2)
2564	Couldn't Cal 19M Ohm (Meas 1)
2565	Couldn't Cal 19M Ohm (Meas 2)
2566	Couldn't Cal 100M Ohm (Meas 1)
2567	Couldn't Cal 1K Ohm (Meas 1)
2568	Couldn't Cal 1K Ohm (Meas 2)
2569	Couldn't Cal 1.9K Ohm (Meas 1)
2570	Couldn't Cal 1.9K Ohm (Meas 2)
2571	Couldn't Cal 100 Ohm (Meas 1)
2572	Couldn't Cal 100 Ohm (Meas 2)
2573	Couldn't Cal 190 Ohm (Meas 1)
2574	Couldn't Cal 190 Ohm (Meas 2)
2575	Couldn't Cal Ohms Divider (Meas 1)
2576	Couldn't Cal Ohms Divider (Meas 2)
2577	Couldn't Cal 10 Ohm (Meas 1)
2578	Couldn't Cal 10 Ohm (Meas 2)
2579	Couldn't Cal 19 Ohm (Meas 1)
2580	Couldn't Cal 19 Ohm (Meas 2)
2581	Couldn't Ext Cal 1 Ohm (0.26V CM Meas)
2582	Couldn't Ext Cal 1 Ohm (Ext Meas)
2583	Couldn't Ext Cal 1 Ohm (0.13V CM Meas)
2584	Couldn't Ext Cal 1 Ohm (Int Meas)
2585	Couldn't Ext Cal 1.9 Ohm (0.18V CM Meas)
2586	Couldn't Ext Cal 1.9 Ohm (0.12V CM Meas)
2587	Couldn't Ext Cal 1.9 Ohm (Int Meas)
2588	Couldn't Cal Wideband Gain
2589	Bad Cal Step Selector
2590	A/D Appears To Have Failed
2591	User Range Gain Adjustment Is 0
2592	Stored User Range Gain Adjust Is 0
2593	220μA AC Flatness Calibration Failed
2594	2.2mA AC Flatness Calibration Failed
2595	22mA AC Flatness Calibration Failed
2596	220mA AC Flatness Calibration Failed
2597	Bad Range Number For IAC Flatness Cal
2598	No Data For DCI Calibration
2599	2.2V AC Flat Early Fail
2600	2.2V AC Flat Software Error
2601	2.2V AC Flat Diverge

2602	22V AC Flat Early Fail
2603	22V AC Flat Software Error
2604	22V AC Flat Diverge
2605	220V AC Flat Early Fail
2606	220V AC Flat Software Error
2607	220V AC Flat Diverge
2608	1100V AC Flat Early Fail
2609	1100V AC Flat Software Error
2610	1100V AC Flat Diverge
2611	220μA IAC Flat Early Fail
2612	220μA IAC Flat Software Error
2613	220μA IAC Flat Diverge
2614	2.2mA IAC Flat Early Fail
2615	2.2mA IAC Flat Software Error
2616	2.2mA IAC Flat Diverge
2617	22mA IAC Flat Early Fail
2618	22mA IAC Flat Software Error
2619	22mA IAC Flat Diverge
2620	220mA IAC Flat Early Fail
2621	220mA IAC Flat Software Error
2622	220mA IAC Flat Diverge
2623	2.2A IAC Flat Early Fail
2624	2.2A IAC Flat Software Error
2625	2.2A IAC Flat Diverge
2626	Illegal Ohms Null Function State
2627	Unknown Source Divider Identifier
2628	No Data For Ohms Calibration
2629	Illegal Ohms Calibration Config
2630	Illegal Number Of Ohms Cal Points
2631	5725 Shunt 0A Meas Fail
2632	5725 Shunt 1.3A Meas Fail
2633	5725 Current Amplifier Zero Meas Fail
2634	5725 Current Amplifier Gain Meas Fail
2635	Wideband Thermal Sensor Cal Diverge
2636	Wideband Sensor Amp Offset Too Big
2637	Wideband Ext Cal Point Bad Const ID
2638	5725 ACV Sense Amp Offset Diverge
2639	5725 ACV Sense Amp Gain Diverge
2640	5725 ACV Flatness Ref Freq Failure
2641	5725 ACV Flatness Cal Freq Failure
2642	External V Reference Value Out Of Range
2643	5725 Diagnostic DAC Cal Didn't Converge
2644	5725 ACV Cap Dac Ref Freq Failure
2645	5725 ACV Cap Dac Cal Freq Failure
2646	DAC Appears To Not Meet Linearity Spec

2700 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (CURRENT)

2700	A7: 8255 Control Word
2701	A7: 8255 Port A Fault
2702	A7: 8255 Port B Fault
2703	A7: 8255 Port C Fault
2704	A7: Dummy Load Fault
2705	A7: Oven Regulation Fault
2706	A7: Current Compliance Fault
2707	A7: Hardware Initialization Fault
2708	A7: Output Current Fault
2709	A7: Current Magnitude Fault
2710	A7: Dummy Load Current Fault
2711	Assembly A7 Is Not Responding
2712	A7: Hi-Res Clock Fault
2713	A7: Hi-Res Loop In 100HZ Range
2714	A7: Hi-Res Loop In 1KHZ Range
2715	A7: Hi-Res Loop In 10KHZ Range
2716	A7: Hi-Res Loop In 100KHZ Range
2717	A7: Hi-Res Loop In 1MHZ Range
2718	In Setting Up AC For Diagnostics
2719	A7: 8255 Was Reset

2800 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (DAC)

2800	A11: 8255 Control Word
2801	A11: 8255 Port A Wires
2802	A11: 8255 Port B Data Bus
2803	A11: 82C54 Status Words
2804	A11: DAC Heaters Not Regulated
2805	5700 Not Warmed Up
2806	A11: ADC Amp Output Noise
2807	A11: ADC Amp Output Offset
2808	A11: ADC Amp Gain Error
2809	A11: DAC Monitoring Fault
2810	A11: +11V DC Range Fault
2811	A11: -11V DC Range Fault
2812	A11: +22V DC Range Fault
2813	A11: -22V DC Range Fault
2814	A11: 6.5V buffered Reference Fault
2815	A11: 6.5V Reference Fault
2816	A11: 13V buffered Reference Fault
2817	A11: 13V Reference Fault
2818	Assembly A11 Missing
2819	A11: 8255 Was Reset
2820	A11: Fine Adjust Channel fault

3100 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (HIGH VOLTAGE)

3100	A14: 8255 Control Word
3101	A14: 8255 Port A Fault
3102	A14: 8255 Port B Fault
3103	A14: 8255 Port C Fault
3104	A15: HV Oven Regulation Fault
3105	A15: HV I Oven Regulation Fault
3106	A15: DC HV Amp Noise Fault
3107	A15: DC HV Amp Offset Fault
3108	A15: DC HV Amp Gain Fault
3109	A15: HV +DC Preamplifier Fault
3110	A15: HV +DC Series Pass & Current Fault
3111	A15: HV +DC High Voltage Output Fault
3112	A15: HV +DC Ref/Error Amplitude Fault
3113	A15: HV -DC Preamplifier Fault
3114	A15: HV -DC Series Pass & Current Fault
3115	A15: HV -DC High Voltage output Fault
3116	A15: HV -DC Reference/Error Amp Fault
3117	A14/A15: HV +DC Current Error Amp Fault
3118	A14/A15: HV -DC Current Error Amp Fault
3119	A14/A15: HV +DC Current Abs. Value
3120	A14/A15: HV -DC Current Abs. Value
3121	A14/A15: HV Range Fault
3122	A14/A15: HV AC 1KHZ, Preamp (lo)
3123	A14/A15: HV AC 1KHZ, Preamp (mid)
3124	A14/A15: HV AC 1KHZ, Preamp (hi)
3125	A14/A15: HV AC 100HZ, Preamp (lo)
3126	A14/A15: HV AC 100HZ, Preamp Fault
3127	A14/A15: HV AC 100HZ, Preamp (hi)
3128	A14/A15: HV AC 1KHZ, Output (lo)
3129	A14/A15: HV AC 1KHZ, Output (mid)
3130	A14/A15: HV AC 1KHZ, Output (hi)
3131	A14/A15: HV AC 100HZ, Output (lo)
3132	A14/A15: HV AC 100HZ, Output (mid)
3133	A14/A15: HV AC 100HZ, Output (hi)
3134	A14/A15: HV AC Volt Loop Convergence
3135	Assembly A14 Not Responding
3136	A14: 8255 Was Reset
3137	A14/A15/A16: 2.2A AC Range Mag. Fault
3138	A14/A15/A16: 2.2A AC Range Compliance
3139	A14/A15/A16: 2.2A AC Range Amplitude
3140	A14/A15/A16: 2.2A AC Range Abs. Value
3141	A14/A15/A16: 2.2A DC Range Dummy Load
3142	A14/A15/A16: 2.2A DC Range Compliance
3143	A14/A15/A16: 2.2A DC Range Magnitude

3200 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (MISC)	
3200	Assemblies Missing
3201	Unknown Diagnostic Test

3300 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (OHMS)	
3300	A9: 8255 Control Word
3301	A9: 8255 Port A Fault
3302	A9: 8255 Port B Fault
3303	A9: 8255 Port C Fault
3304	A9: 10V Source Fault
3305	A9: 5V Source Fault
3306	A9: 2V Source Fault
3307	A9: 2V Checkpoint Fault
3308	A9: Diff Amp Offset Fault
3309	A9: Diff Amp Gain Fault
3310	A9/A11: Diff Amp Zero Fault
3311	A9/A10: Ohms 10:1 Divider Fault
3312	A9/A10: Ohms 1:1 Divider Fault
3313	A9/A10: 10K Ohm Diagnostic Fault
3314	A9/A10: 19K Ohm Cal Diag Fault
3315	A9/A10: 10 Ohm Cal Diag Fault
3316	A9/A10: 19 Ohm Cal Diag Fault
3317	A9/A10: 100K Ohm Ratio Fault
3318	A9/A10: 190K Ohm Ratio Fault
3319	A9/A10: 1M Ohm Ratio Fault
3320	A9/A10: 1.9M Ohm Ratio Fault
3321	A9/A10: 10M Ohm Ratio Fault
3322	A9/A10: 19M Ohm Ratio 1
3323	A9/A10: 19M Ohm Ratio 2
3324	A9/A10: 100M Ohm Ratio Fault
3325	A9/A10: 10K Ohm Check Fault
3326	A9/A10: 19K Ohm Check Fault
3327	A9/A10: 1K Ohm Check Fault
3328	A9/A10: 1.9K Ohm Check Fault
3329	A9/A10: 100 Ohm Check Fault
3330	A9/A10: 190 Ohm Check Fault
3331	A9/A10: 10 Ohm Check Fault
3332	A9/A10: 19 Ohm Check Fault
3333	A9/A10: 1 Ohm Check Fault
3334	A9/A10: 1.9 Ohm Check Fault
3335	A9/A10: Ohms Short Check Fault
3336	A9/A10: 2 Wire Compensation Fault
3337	A9/A10: Ohms Correction Factor Fault
3338	Assembly A9 Not Responding
3339	A9: 8255 Was Reset

3400 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (OSCILLATOR)	
3400	A12: 8255 Control Word
3401	A12: 8255 Port A
3402	A12: 8255 Port B
3403	A12: 8255 Port C
3404	A13: 8255 Control Word
3405	A13: 8255 Port A
3406	A13: 8255 Port B
3407	A13: 8255 Port C
3408	A12: Fixed Ampl. Osc Fault
3409	A12: Phase Lock Loop Fault
3410	A12/A13: 22V Amp Bias Adj Error
3411	A12/A13: 22V Amp Nonfunctional
3412	A12 To A13 Interface Fault
3413	A12/A13: 14 bit DAC Nonfunctional
3414	A12/A13: Nonlinear Control Loop 2Vrng
3415	A12/A13: nonlinear Control Loop 20Vrng
3416	A12/A13: DAC 15th Bit Fault
3417	A12: DC Sensor Buffer Fault
3418	A12: Sensor Loop/Sq. Root Amp Fault
3419	A12: AC Sensor Buff (2V Range)
3420	A12: AC Sensor Buff (20V Range)
3421	A12: AC Cal Sensor (2V Range)
3422	A12: AC Cal Sensor (20V Range)
3423	Assembly A12 Missing
3424	Assembly A13 Missing
3425	Assembly A12 Or A13 Not Responding
3426	A12: 8255 Was Reset
3427	A13: 8255 Was Reset

3500 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (POWER AMP)	
3500	A16: 8255 Control Word
3501	A16: 8255 Port A
3502	A16: 8255 Port B
3503	A16: 8255 Port C
3504	SDI Spare 1
3505	SDI Spare 2
3506	SDI Spare 3
3507	A16: PA Supplies Are Off
3508	A16/A14: 220V AC Range Output Fault
3509	A16: Amplifier Loop Not Regulated
3510	A16: 220V Amp Fault
3511	A16: Incorrect PA Input
3512	SDI Spare 4
3513	SDI Spare 5
3514	SDI Spare 6
3515	SDI Spare 7
3516	SDI Spare 8
3517	SDI Spare 9
3518	A16: BR6 Not At PA Input
3519	A16: BR13 Not At PA Input
3520	A16: PA Oven Regulation Fault

3521	Assembly A16 Is Not Responding
3522	A16: PA+ Supply Fault
3523	A16: PA- Supply Fault
3524	A16: Power Amp Is Too Hot
3525	220V DC Initialization Fault
3526	220V AC Initialization Fault
3527	A16: Power Amp DC Cal Network Zero Fault
3528	A16: Power Amp DC Cal Network Gain Fault
3529	A16: Pwr Amp 220V Range Attenuator Fault
3530	A16: 8255 Was Reset

3600 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (POWER SUPPLIES)

3600	+17S Supply Fault
3601	-17S Supply Fault
3602	+15S Supply Fault
3603	-15S Supply Fault
3604	+42S Supply Fault
3605	-42S Supply Fault
3606	+5LH Supply Fault
3607	-5LH Supply Fault
3608	5RLH Supply Fault
3609	8RLH Supply Fault
3610	+PA Supply Fault
3611	-PA Supply Fault
3612	+15 OSC Supply Fault
3613	-15 OSC Supply Fault

3700 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (REAR I/O)

3700	A21: 8255 Control Word
3701	A21: 8255 Port A Fault
3702	A21: 8255 Port B Fault
3703	A21: 8255 Port C Fault
3704	Assembly A21 Not Responding
3705	A21: Rear Panel Data Bus Fault
3706	A21: Rear Panel Duart Chan A Fault
3707	A21: Rear Panel Duart Chan B Fault
3708	A21: 8255 Was Reset

3800 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (SWITCH MATRIX)

3800	A8: 8255 Control Word
3801	A8: 8255 Port A Fault
3802	A8: 8255 Port B Fault
3803	A8: 8255 Port C Fault
3804	A8: Zero Amp Lo Noise Fault
3805	A8: Zero Amp Lo Offset
3806	A8: Zero Amp Lo Gain Fault
3807	A8: Zero Amp Hi Noise Fault
3808	A8: Zero Amp Hi Offset
3809	A8: Zero Amp Hi Gain Fault

3810	A8: 2.2V Amp Noise Fault
3811	A8: Zero Amp Offset
3812	A8: 2.2V Gain Fault
3813	A8: 220mV Offset Fault
3814	A8: 220mV Divider Fault
3815	A8: 22mV Divider Fault
3816	Motherboard Relays K1/K2 Fault
3817	A8: Sense Lo Relay Fault
3818	A8: Out Lo To Sense Lo Continuity Fault
3819	A8: Relay Fault
3820	A8: K21? Relay Fault
3821	A8: K33? Relay Fault
3822	A8: K9? Relay Fault
3823	A8: K28? Relay Fault
3824	A8: Oven Regulation Fault
3825	Assembly A8 Not Responding
3826	A8: 8255 Was Reset
3827	Assembly A8 Too Hot

3900 LEVEL FAULTS: SELF DIAGNOSTICS SUBSYSTEM (WIDEBAND)

3900	A5: 8255 Control Word
3901	A5: 8255 Port A Fault
3902	A5: 8255 Port B Fault
3903	A5: 8255 Port C Fault
3904	Optional Assemblies A5/A6 Are Missing
3905	A6: Phase Lock Loop At 10Mhz
3906	A6: Phase Lock Loop At 30Mhz
3907	A5: RMS Sensor At 10Mhz
3908	A5: RMS Sensor At 30Mhz
3909	A5: RMS Sensor At 6.5V DC in
3910	A5/A6: Ampl. Control At 10Mhz
3911	A5/A6: Ampl. Control At 30Mhz
3912	A5/A6: Output Offset At 10Mhz
3913	A5/A6: Output Offset At 30Mhz
3914	A5: 0DB Output Attenuation Fault
3915	A5: 10DB Output Attenuation Fault
3916	A5: 20DB Output Attenuation Fault
3917	A5: 30DB Output Attenuation Fault
3918	A5: 40DB Output Attenuation Fault
3919	A5: 50DB Output Attenuation Fault
3920	A5: 60DB Output Attenuation Fault
3921	A5: 70DB Output Attenuation Fault
3922	A5/A6: Wideband Initialization Fault
3923	A5: 8255 Was Reset

4000 LEVEL FAULTS: ANALOG SEQUENCING SUBSYSTEM	
4000	Bad Sequence ID
4001	Over Nested Subsequences
4002	Bad Sequence Command Code
4003	Bad Reply Size From Inguard
4004	Reply From Inguard Too Small
4005	False MSG Semaphore from Inguard
4006	Inguard CPU POP
4007	Inguard CPU Reset
4008	Inguard CPU A/D Timeout
4009	Inguard CPU Timed Out On Main CPU
4010	Inguard CPU Detected A Command Error
4011	Bad Y5000 Get/Set Selector
4012	Sequencer Timed Out Waiting For Inguard
4013	Illegal Analog State Command For 5725
4014	Sequencer Timed Out Waiting for 5725
4015	Couldn't Queue Command To 5725 BX
4016	Reply From 5725 Was Garbled

4100 LEVEL FAULTS: SERIAL INTERFACE DRIVER SUBSYSTEM	
4100	Bad Virtual channel
4101	Framing
4102	Input Queue Overflow
4103	Overrun
4104	Parity
4105	Uart Failed Self Test

4200 LEVEL FAULTS: INSTRUMENT STATE MANAGER SUBSYSTEM	
4200	Bad Boolean Value Selector
4201	Meaningless Target State Value
4202	Meaningless Actual State Value
4203	Mystery Target/Actual State Difference

4301 LEVEL FAULTS: SELF TEST SUBSYSTEM	
4301	ROM Checksum
4302	RAM
4303	Real Time Clock
4304	Keyboard
4305	Output Display
4306	Control Display
4307	IEEE488
4308	Rear Panel DUART
4309	Guard Crossing DUART
4310	Interrupt Hardware
4311	Inguard CPU ROM Fault
4312	Inguard CPU RAM Fault
4313	Front Panel Refresh Fault

4400 LEVEL FAULTS: GENERAL PURPOSE UTILITY SUBSYSTEM	
440	Invalid Command

4500 LEVEL FAULTS: ANALOG VALUE FINDER SUBSYSTEM	
4500	VFdcDac Value Out Of DAC Range
4501	Bad Range Selector
4502	Non-Vfinder Range
4503	Bad DAC ICALL
4504	User Range Adjust of 0 (I used 1)
4505	Divide By 0 In (VF)correct

4600 LEVEL FAULTS: WATCH DOG MONITORING SUBSYSTEM	
4600	Watchdog Timed Out

4700 LEVEL FAULTS: OPERATING KERNEL SUBSYSTEM	
4700	Kstart Returned
4701	Task Termination
4702	No Signal Handler
4703	Ksuspend() When Not RUNNING
4704	Ksleep() When Not RUNNING
4705	Kevwait() When Not RUNNING

Appendix B
Glossary

adc (analog-to-digital converter)

A device or circuit that converts an analog voltage to digital signals.

absolute uncertainty

Uncertainty specifications that include the error contributions made by all equipment and standards used to calibrate the instrument. Absolute uncertainty is the number to compare with the UUT for determining test uncertainty ratio.

accuracy

The degree to which the measured value of a quantity agrees with the true (correct) value of that quantity. Accuracy is the same as 1 - % uncertainty. (See "uncertainty".) For example, an instrument specified to ±1% uncertainty is 99% accurate.

assert

To cause a digital signal line to go into a logic true state.

af (audio frequency)

The frequency range of human hearing; normally 15 - 20,000 Hz.

artifact standard

An object that produces or embodies a physical quantity to be standardized, for example a Fluke 732A dc Voltage Reference Standard.

base units

Units in the SI system that are dimensionally independent. All other units are derived from base units. The only base unit in electricity is the ampere.

buffer

1. An area of digital memory for temporary storage of data. 2. An amplifier stage before the final amplifier.

burden voltage

The maximum sustainable voltage across the terminals of a load.

calibration check

A fast, simple, automated procedure to provide added confidence between calibration recalls, and data that can be used to develop a history of 5700A performance between calibrations. No changes are made to stored constants, and the internal check standards are used as the reference points instead of external standards as in the routine calibration procedure.

calibrate

To compare a measurement system or device of unknown accuracy to a measurement system or device of known and greater accuracy to detect or correct any variation from required performance of the unverified measurement system or device.

calibration

The comparison of a measurement system or device of unknown accuracy to a measurement system or device of known and greater accuracy to detect or correct any variation from required performance of the unverified measurement system or device.

calibration constant

A correction factor that is applied manually or automatically to correct the output or reading of an instrument.

calibration curve

A smooth curve drawn through a graph of calibration points.

calibration interval

The interval after which calibration must occur to maintain the performance of an instrument as stated in its specifications.

calibration report

A record of uncertainty and/or correction factors for an instrument as determined during calibration.

calibrator

A device that supplies outputs with a known uncertainty for use in checking the accuracy of measurement devices.

check standard

A device used solely to verify the integrity of another standard. For example in the 5700A, one Fluke RMS sensor continuously monitors the output voltage while a second Fluke RMS sensor confirms the integrity of the first.

characterization

The development of a table of calibration constants or correction factors for use in correcting the output or reading of an instrument.

common mode noise

An undesired signal that exists between a device's terminals and ground. Common mode noise is at the same potential on both terminals of a device.

compliance voltage

The maximum voltage a constant-current source can supply.

control chart

A chart devised to monitor one or more processes in order to detect the excessive deviation from a desired value of a component or process.

crest factor

The ratio of the peak voltage to the rms voltage of a waveform (with the dc component removed).

current guard

A generator that drives the inner shield of a triaxial cable with a signal of the same amplitude and phase as a Calibrator's ac current output signal on the center conductor. The current guard shields the Calibrator's output signal from a capacitive leakage path to ground.

dac (digital-to-analog converter)

A device or circuit that converts a digital waveform to an analog voltage.

dBm

Power level expressed as decibels above or below 1 mW.

derived units

Units in the SI system that are derived from base units. Volts, ohms, and watts are derived from amperes and other base and derived units.

distortion

Undesired changes in the waveform of a signal. Harmonic distortion disturbs the original relationship between a frequency and other frequencies naturally related to it. Intermodulation distortion (imd) introduces new frequencies by the mixing of two or more original frequencies. Other forms of distortion are phase distortion and transient distortion.

errors

The different types of errors described in this glossary are "offset error", "linearity error", "random error", "scale error", "systematic errors", and "transfer error".

flatness

A measure of the variation of the actual output of an ac voltage source at different frequency points when set to the same nominal output level. A flat voltage source exhibits very little error throughout its frequency range.

floor

The part of the uncertainty specification of an instrument that is typically a fixed offset plus noise. Floor can be expressed as units such as microvolts or counts of the least significant digit. For the 5700A, the floor specification is combined with fixed range errors in one term.

full scale

The maximum reading of a range of a meter, analog-to-digital converter, or other measurement device, or the maximum attainable output on a range of a calibrator.

gain error

Same as scale error. Scale or gain error results when the slope of the meter's response curve is not exactly 1. A meter with only gain error (no offset or linearity error), will read 0V with 0V applied, but something other than 10V with 10V applied.

ground

The voltage reference point in a circuit. Earth ground is a connection through a ground rod or other conductor to the earth, usually accessible through the ground conductor in an ac power receptacle.

ground loops

Undesirable currents induced when there is more than one chassis ground potential in a system of instruments. Ground loops can be minimized by connecting all instruments in a system to ground to one point.

guard

See "voltage guard" and "current guard".

International System of Units

Same as "SI System of Units"; the accepted system of units. See also "units", "base units", and "derived units".

legal units

The highest echelon in a system of units, for example the U.S. National Bureau of Standards volt.

life-cycle cost

The consideration of all elements contributing to the cost of an instrument throughout its useful life. This includes initial purchase cost, service and maintenance cost, and the cost of support equipment.

linearity

The relationship between two quantities when a change in the first quantity is directly proportional to a change in the second quantity.

linearity error

Linearity error occurs when when the response curve of a meter is not exactly a straight line. This type of error is measured by fixing two points on the response curve, drawing a line through the points, then measuring how far the curve deviates from the straight line at various points on the response curve.

MAP (Measurement Assurance Program)

A program for a measurement process. A MAP provides information to demonstrate that the total uncertainty of the measurements (data), including both random error and systematic components of error relative to national or other designated standards is quantified, and sufficiently small to meet requirements.

MTBF (Mean Time Between Failures)

The time interval in operating hours that can be expected between failure of equipment. MTBF can be calculated from direct observation or mathematically derived through extrapolation.

MTTF (Mean Time to Fail)

The time interval in operating hours that can be expected until the first failure of equipment. MTF can be calculated from direct observation or mathematically derived through extrapolation.

MTTR (Mean Time to Repair)

The average time in hours required to repair failed equipment.

metrology

The science of, and the field of knowledge concerned with measurement.

minimum use specifications

A compilation of specifications that satisfies the calibration requirements of a measurement system or device. The minimum use specifications are usually determined by maintaining a specified test uncertainty ratio between the calibration equipment and the unit under test. The 5700A Service Manual contains a table of minimum use specifications for performing full verification.

noise

A signal containing no useful information that is superimposed on a desired or expected signal.

normal mode noise

An undesired signal that appears between the terminals of a device.

offset error

Same as zero error. The reading shown on a meter when an input value of zero is applied is its offset or zero error.

parameters

Independent variables in a measurement process such as temperature, humidity, test lead resistance, etc.

precision

The degree of agreement among independent measurements of a quantity under the same conditions. (Same as "repeatability".)

The precision of a measurement process is the coherence, or the closeness to the one result, of all measurement results. High precision, for example would result in a tight pattern of arrow hits on a target, without respect to where on the target the tight pattern falls.

predictability

A measure of how accurately the output value of a device can be assumed after a known time following calibration. If a device is highly stable, it is also predictable. If a device is not highly stable, but its value changes at the same rate every time after calibration, it's output has a higher degree of predictability than a device that exhibits random change.

primary standard

A standard defined and maintained by some authority and used to calibrate all other secondary standards.

process metrology

Tracking the accuracy drift of calibration and other equipment by applying statistical analysis to correction factors obtained during calibration.

random error

Any error which varies in an unpredictable manner in absolute value and in sign when measurements of the same value of a quantity are made under effectively identical conditions.

range

The stated upper end of a measurement device's span. Usually, however, a measurement device can measure quantities for a specified percentage overrange. (The absolute span including overrange capability is called "scale.") In the 5700A, however, range and scale are identical.

range calibration

An optional calibration procedure available to the enhance the 5700A specifications by nulling the output to an external standard.

reference amplifier

DC voltage references developed for the 5700A. These are 6.5V hybrid devices consisting of a zener diode and a transistor on a heated substrate. These reference amplifiers exhibit extremely low uncertainty and drift, and are superior to zener diode or temperature-compensated zener diode voltage references.

reference standard

The highest-echelon standard in a laboratory; the standard that is used to maintain working standards that are used in routine calibration and comparison procedures.

relative uncertainty

5700A uncertainty specifications that exclude the effects of external dividers and standards, for use when range constants are adjusted. Relative uncertainty includes only the stability, temperature coefficient, noise, and linearity specifications of the 5700A itself.

reliability

A measure of the "uptime" of an instrument.

repeatability

The degree of agreement among independent measurements of a quantity under the same conditions. (Same as "precision".)

resistance

A property of a conductor that determines the amount of current that will flow when a given amount of voltage exists across the conductor. Resistance is measured in ohms. One ohm is the resistance through which one volt of potential will cause one ampere of current to flow.

resolution

The smallest change in quantity that can be detected by a measurement system or device. For a given parameter, resolution is the smallest increment that can be measured, generated or displayed.

rf (radio frequency)

The frequency range of radio waves; from 150 kHz up to the infrared range.

rms (root-mean-square)

The value assigned to an ac voltage or current that results in the same power dissipation in a resistance as a dc current or voltage of the same value.

rms sensor

A device that converts ac voltage to dc voltage with great accuracy. RMS sensors operate by measuring the heat generated by a voltage through a known resistance (i.e., power); therefore, they sense true rms voltage.

scale

The absolute span of the reading range of a measurement device including overrange capability.

scale error

Same as gain error. Scale or gain error results when the slope of the meter's response curve is not exactly 1. A meter with only scale error (no offset or linearity error), will read 0V with 0V applied, but something other than 10V with 10V applied.

secondary standard

A standard maintained by comparison against a primary standard.

sensitivity

The degree of response of a measuring device to the change in input quantity, or a figure of merit that expresses the ability of a measurement system or device to respond to an input quantity.

shield

A grounded covering device designed to protect a circuit or cable from electromagnetic interference.

SI System of Units

The accepted International System of Units. See also "units", "base units", and "derived units.

specifications

A precise statement of the set of requirements satisfied by a measurement system or device.

stability

A measure of the freedom from drift in value over time and over changes in other variables such as temperature. Note that stability is not the same as uncertainty.

standard

A device that is used as an exact value for reference and comparison.

standard cell

A primary cell that serves as a standard of voltage. The term "standard cell" often refers to a "Weston normal cell", which is a wet cell with a mercury anode, a cadmium mercury amalgam cathode, and a cadmium sulfate solution as the electrolyte.

systematic errors

Errors in repeated measurement results that remain constant or vary in a predictable way.

temperature coefficient

A factor per °C deviation from a nominal value or range that the uncertainty of an instrument increases. This specification is necessary to account for the thermal coefficients in a calibrator's analog circuitry.

test uncertainty ratio

The numerical ratio of the uncertainty of the measurement system or device being calibrated to the uncertainty of the measurement system or device used as the calibrator. (Also called "test accuracy ratio".)

thermal emf

The voltage generated when two dissimilar metals joined together are heated.

traceability

The ability to relate individual measurement results to national standards or nationally accepted measurement systems through an unbroken chain of comparisons, i.e., a calibration "audit trail".

Measurements, measurement systems or devices have traceability to the designated standards if and only if scientifically rigorous evidence is produced on a continuing basis to show that the measurement process is producing measurement results for which the total measurement uncertainty relative to national or other designated standards is qualified.

transfer error

The sum of all new errors induced during the process of comparing one quantity against another.

transfer standard

Any working standard used to compare a measurement process, system or device at one location or level with another measurement process, system, or device at another location or level.

transport standard

A transfer standard that is rugged enough to allow shipment by common carrier to another location.

true value

Also called legal value, the accepted, consensus, i.e., the correct value of the quantity being measured.

uncertainty

The maximum difference between the accepted, consensus, or true value and the measured value of a quantity. Uncertainty is normally expressed in units of ppm (parts per million) or as a percentage. (Accuracy is the same as 1 - % uncertainty.)

units

Symbols or names that define the measured quantities. Examples of units are: V, mV, A, kW, and dBm. See also "SI System of Units".

UUT (Unit Under Test)

An abbreviated name for an instrument that is being tested or calibrated.

volt

The unit of emf (electromotive force) or electrical potential in the SI system of units. One volt is the difference of electrical potential between two points on a conductor carrying one ampere of current, when the power being dissipated between these two points is equal to one watt.

watt

The unit of power in the SI system of units. One watt is the power required to do work at the rate of one joule/second. In terms of volts and ohms, one watt is the power dissipated by one ampere flowing through a one-ohm load.

wideband

Ac voltage at frequencies up to and including the radio frequency spectrum.

verification

Checking the functional performance and uncertainty of an instrument or standard without making adjustments to it or changing its calibration constants.

voltage guard

A floating shield around voltage measurement circuitry inside an instrument. The voltage guard provides a low-impedance path to ground for common-mode noise and ground currents, thereby eliminating errors introduced by such interference.

working standard

A standard that is used in routine calibration and comparison procedures in the laboratory, and is maintained by comparison to reference standards.

zero error

Same as offset error. The reading shown on a meter when an input value of zero is applied is its zero or offset error.

Appendix C
ASCII and IEEE-488 Bus Codes

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
NUL	0	000	00	0000 0000		GTL	ADDRESSED COMMANDS
SOH	1	001	01	0000 0001			
STX	2	002	02	0000 0010			
ETX	3	003	03	0000 0011			
EOT	4	004	04	0000 0100		SDC	
ENQ	5	005	05	0000 0101		PPC	
ACK	6	006	06	0000 0110			
BELL	7	007	07	0000 0111			
BS	8	010	08	0000 1000		GET	
HT	9	011	09	0000 1001		TCT	
LF	10	012	0A	0000 1010			
VT	11	013	0B	0000 1011			
FF	12	014	0C	0000 1100			
CR	13	015	0D	0000 1101			
SO	14	016	0E	0000 1110			
SI	15	017	0F	0000 1111			
DLE	16	020	10	0001 0000		LLO	UNIVERSAL COMMANDS
DC1	17	021	11	0001 0001			
DC2	18	022	12	0001 0010			
DC3	19	023	13	0001 0011			
DC4	20	024	14	0001 0100		DCL	
NAK	21	025	15	0001 0101		PPU	
SYN	22	026	16	0001 0110			
ETB	23	027	17	0001 0111			
CAN	24	030	18	0001 1000		SPE	
EM	25	031	19	0001 1001		SPD	
SUB	26	032	1A	0001 1010			
ESC	27	033	1B	0001 1011			
FS	28	034	1C	0001 1100			
GS	29	035	1D	0001 1101			
RS	30	036	1E	0001 1110			
US	31	037	1F	0001 1111			
SPACE	32	040	20	0010 0000	0	MLA	LISTEN ADDRESSES
!	33	041	21	0010 0001	1	MLA	
"	34	042	22	0010 0010	2	MLA	
#	35	043	23	0010 0011	3	MLA	
$	36	044	24	0010 0100	4	MLA	
%	37	045	25	0010 0101	5	MLA	
&	38	046	26	0010 0110	6	MLA	
'	39	047	27	0010 0111	7	MLA	
(	40	050	28	0010 1000	8	MLA	
)	41	051	29	0010 1001	9	MLA	
*	42	052	2A	0010 1010	10	MLA	
+	43	053	2B	0010 1011	11	MLA	
,	44	054	2C	0010 1100	12	MLA	
-	45	055	2D	0010 1101	13	MLA	
.	46	056	2E	0010 1110	14	MLA	
/	47	057	2F	0010 1111	15	MLA	
0	48	060	30	0011 0000	16	MLA	
1	49	061	31	0011 0001	17	MLA	
2	50	062	32	0011 0010	18	MLA	
3	51	063	33	0011 0011	19	MLA	
4	52	064	34	0011 0100	20	MLA	
5	53	065	35	0011 0101	21	MLA	
6	54	066	36	0011 0110	22	MLA	
7	55	067	37	0011 0111	23	MLA	
8	56	070	38	0011 1000	24	MLA	
9	57	071	39	0011 1001	25	MLA	
:	58	072	3A	0011 1010	26	MLA	
;	59	073	3B	0011 1011	27	MLA	
<	60	074	3C	0011 1100	28	MLA	
=	61	075	3D	0011 1101	29	MLA	
>	62	076	3E	0011 1110	30	MLA	
?	63	077	3F	0011 1111		UNL	

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	
@	64	100	40	0100 0000	0	MTA	TALK ADDRESSES
A	65	101	41	0100 0001	1	MTA	
B	66	102	42	0100 0010	2	MTA	
C	67	103	43	0100 0011	3	MTA	
D	68	104	44	0100 0100	4	MTA	
E	69	105	45	0100 0101	5	MTA	
F	70	106	46	0100 0110	6	MTA	
G	71	107	47	0100 0111	7	MTA	
H	72	110	48	0100 1000	8	MTA	
I	73	111	49	0100 1001	9	MTA	
J	74	112	4A	0100 1010	10	MTA	
K	75	113	4B	0100 1011	11	MTA	
L	76	114	4C	0100 1100	12	MTA	
M	77	115	4D	0100 1101	13	MTA	
N	78	116	4E	0100 1110	14	MTA	
O	79	117	4F	0100 1111	15	MTA	
P	80	120	50	0101 0000	16	MTA	
Q	81	121	51	0101 0001	17	MTA	
R	82	122	52	0101 0010	18	MTA	
S	83	123	53	0101 0011	19	MTA	
T	84	124	54	0101 0100	20	MTA	
U	85	125	55	0101 0101	21	MTA	
V	86	126	56	0101 0110	22	MTA	
W	87	127	57	0101 0111	23	MTA	
X	88	130	58	0101 1000	24	MTA	
Y	89	131	59	0101 1001	25	MTA	
Z	90	132	5A	0101 1010	26	MTA	
[	91	133	5B	0101 1011	27	MTA	
\	92	134	5C	0101 1100	28	MTA	
]	93	135	5D	0101 1101	29	MTA	
^	94	136	5E	0101 1110	30	MTA	
_	95	137	5F	0101 1111		UNT	
`	96	140	60	0110 0000	0	MSA	SECONDARY ADDRESSES
a	97	141	61	0110 0001	1	MSA	
b	98	142	62	0110 0010	2	MSA	
c	99	143	63	0110 0011	3	MSA	
d	100	144	64	0110 0100	4	MSA	
e	101	145	65	0110 0101	5	MSA	
f	102	146	66	0110 0110	6	MSA	
g	103	147	67	0110 0111	7	MSA	
h	104	150	68	0110 1000	8	MSA	
i	105	151	69	0110 1001	9	MSA	
j	106	152	6A	0110 1010	10	MSA	
k	107	153	6B	0110 1011	11	MSA	
l	108	154	6C	0110 1100	12	MSA	
m	109	155	6D	0110 1101	13	MSA	
n	110	156	6E	0110 1110	14	MSA	
o	111	157	6F	0110 1111	15	MSA	
p	112	160	70	0111 0000	16	MSA	
q	113	161	71	0111 0001	17	MSA	
r	114	162	72	0111 0010	18	MSA	
s	115	163	73	0111 0011	19	MSA	
t	116	164	74	0111 0100	20	MSA	
u	117	165	75	0111 0101	21	MSA	
v	118	166	76	0111 0110	22	MSA	
w	119	167	77	0111 0111	23	MSA	
x	120	170	78	0111 1000	24	MSA	
y	121	171	79	0111 1001	25	MSA	
z	122	172	7A	0111 1010	26	MSA	
{	123	173	7B	0111 1011	27	MSA	
|	124	174	7C	0111 1100	28	MSA	
}	125	175	7D	0111 1101	29	MSA	
~	126	176	7E	0111 1110	30	MSA	
	127	177	7F	0111 1111			

Appendix D
Symbolic Names of Calibration Constants

NAME	DESCRIPTION
D3P	11 V range, positive zero
D3M	11 V range, negative zero
D4P	22 V range, positive zero
D4M	22 V range, negative zero
KV6	6.5V reference true value
KV13	13V reference true value
BV6	6.5V buffered reference value
BV13	13V buffered reference value
KDAC	DAC channel ratio
KADC	A/D scale constant (gain of one range)
DACLIN	DAC linearity
APDC	220V dc cal attenuator constant
KZAL	Switch Matrix zero amp gain (low setting)
ZA220	220 mV attenuator - zero amp combo offset
ZA2V	2V attenuator - zero amp combo offset
D1P	220 mV range offset
D1G	220 mV range gain
D2P	2.2V range offset
D2G	2.2V range gain
D3G	11V range positive gain
D3N	11V range negative gain
D4G	22V range positive gain
D4N	22V range negative gain
D5P	220V range zero offset
D5G	220V range gain
D6P	1100V range zero offset
D6G	1100V range gain
KRMS	AC V sense return buffer offset
OSUP	Upward 15-bit dac hysteresis offset
OSDN	Downward 15-bit dac hysteresis offset
A1G	2.2 mV range gain
A1S	2.2 mV range standing wave ratio correction
A2G	22 mV range gain
A2S	22 mV range standing wave ratio correction
A3G	220 mV range gain

NAME	DESCRIPTION
A3S	220 mV range standing wave ratio correction
A4G	2.2V range gain
A4S	2.2V range standing wave ratio correction
A4D	2.2V range 8-bit dac constant
A4F1	2.2V range, flatness correction, 20 kHz
A4F2	Same, 50 kHz
A4F3	Same, 100 kHz
A4F4	Same, 119.99 kHz
A4F5	Same, 120 kHz
A4F6	Same, 200 kHz
A4F7	Same, 300 kHz
A4F8	Same, 400 kHz
A4F9	Same, 500 kHz
A4FA	Same, 600 kHz
A4FB	Same, 700 kHz
A4FC	Same, 800 kHz
A4FD	Same, 900 kHz
A4FE	Same, 1 MHz
A4FF	Same, 1.1 MHz
A4FG	Same, 1.1999 MHz
A4FH	(Spare)
A4FI	(Spare)
A4C1	2.2V range, first convergence correction, 10 Hz
A4C2	Same, 200 Hz
A4C3	Same, 5 kHz
A4C4	Same, 20 kHz
A4C5	Same, 50 kHz
A4C6	Same, 70 kHz
A4C7	Same, 100 kHz
A4C8	Same, 119.99 kHz
A4C9	Same, 200 kHz
A4CA	Same, 300 kHz
A4CB	Same, 400 kHz
A4CC	Same, 500 kHz
A4CD	Same, 600 kHz
A4CE	Same, 700 kHz
A4CF	Same, 800 kHz
A4CG	Same, 900 kHz
A4CH	Same, 1 MHz
A4CI	Same, 1.1 MHz
A4CJ	Same, 1.1999 MHz
A4V1	2.2V range, first 1/V convergence correction, 10 Hz
A4V2	Same, 200 Hz
A4V3	Same, 5 kHz
A4V4	Same, 20 kHz

NAME	DESCRIPTION
TW2	Manual range adjust, 2.2V dc
TW3	Manual range adjust, 11V dc
TW4	Manual range adjust, 22V dc
TW5	Manual range adjust, 220V dc
TW6	Manual range adjust, 1100V dc
TW7	Manual range adjust, 1100V dc with 5205A
TW8	Manual range adjust, 2.2 mV ac
TW9	Manual range adjust, 22 mV ac
TW10	Manual range adjust, 220 mV ac
TW11	Manual range adjust, 2.2V ac
TW12	Manual range adjust, 22V ac
TW13	Manual range adjust, 220V ac
TW14	Manual range adjust, 1100V ac
TW15	Manual range adjust, 1100V ac with 5725A
TW16	Manual range adjust, 1100V ac with 5215A
TW17	Manual range adjust, 1100V ac with 5205A
TW18	Manual range adjust, 220 μA dc
TW19	Manual range adjust, 2.2 mA dc
TW20	Manual range adjust, 22 mA dc
TW21	Manual range adjust, 220 mA dc
TW22	Manual range adjust, 2.2A dc
TW23	Manual range adjust, 11A dc with 5725A
TW24	Manual range adjust, 20A dc with 5220A
TW25	Manual range adjust, 220 μA ac
TW26	Manual range adjust, 2.2 mA ac
TW27	Manual range adjust, 22 mA ac
TW28	Manual range adjust, 220 mA ac
TW29	Manual range adjust, 2.2A ac
TW30	Manual range adjust, 11A ac with 5725A
TW31	Manual range adjust, 20A ac with 5220A
TW32	Manual range adjust, 1.1 mV wideband ac
TW33	Manual range adjust, 3.3 mV wideband ac
TW34	Manual range adjust, 11 mV wideband ac
TW35	Manual range adjust, 33 mV wideband ac
TW36	Manual range adjust, 110 mV wideband ac
TW37	Manual range adjust, 330 mV wideband ac
TW38	Manual range adjust, 1.1V wideband ac
TW39	Manual range adjust, 3.5V wideband ac
TW40	Manual range adjust, 0Ω
TW41	Manual range adjust, 1Ω
TW42	Manual range adjust, 1.9Ω
TW43	Manual range adjust, 10Ω
TW44	Manual range adjust, 19Ω
TW45	Manual range adjust, 100Ω
TW46	Manual range adjust, 190Ω

NAME	DESCRIPTION
TW47	Manual range adjust, 1 kΩ
TW48	Manual range adjust, 1.9 kΩ
TW49	Manual range adjust, 10 kΩ
TW50	Manual range adjust, 19 kΩ
TW51	Manual range adjust, 100 kΩ
TW52	Manual range adjust, 190 kΩ
TW53	Manual range adjust, 1 MΩ
TW54	Manual range adjust, 1.9 MΩ
TW55	Manual range adjust, 10 MΩ
TW56	Manual range adjust, 19 MΩ
TW57	Manual range adjust, 100 MΩ
TW58	(Spare)
TW59	(Spare)
TW60	(Spare)
5725__SET	5725A set selector
ABG	1100V ac gain constant (5725A)
ABS	1100V ac standing wave ratio correction (5725A)
ABZ	1100A ac sense amp offset (5725A)
ABCAP	5725A capacitive dac setting
ABF1	5725A flatness constants, 1 kHz
ABF2	5725A flatness constants, 5 kHz
ABF3	5725A flatness constants, 10 kHz
ABF4	5725A flatness constants, 12 kHz
ABF5	5725A flatness constants, 15 kHz
ABF6	5725A flatness constants, 17 kHz
ABF7	5725A flatness constants, 20 kHz
ABF8	5725A flatness constants, 30 kHz
ABF9	5725A flatness constants, 30.01 kHz
ABFA	5725A flatness constants, 40 kHz
ABFB	5725A flatness constants, 50 kHz
ABFC	5725A flatness constants, 60 kHz
ABFD	5725A flatness constants, 70 kHz
ABFE	5725A flatness constants, 80 kHz
ABFF	5725A flatness constants, 90 kHz
ABFG	5725A flatness constants, 100 kHz
IDBG	10A dc gain constant (5725A)
IABG	10A ac gain constant (5725A)
IBZ	10A dc current zero (5725A)
DB2__0	Monitor dac value for 2.0V output
DB1__8	Monitor dac value for 1.8V output
CAL5725__TEMP	Recorded temperature for 5725A calibration

NAME	DESCRIPTION
R100K	100 kΩ true value
R190K	190 kΩ true value
R1M	1 MΩ true value
R1_9M	1.9 MΩ true value
R10M	10 MΩ true value
R19M	19 MΩ true value
R100M	100 MΩ true value
RDIV10	Divider ratio Ohms Cal assembly to get 10V from 13V ref
RDIV5	Divider ratio Ohms Cal assembly to get 5V from 13V ref
RDIV2	Divider ratio Ohms Cal assembly to get 2V from 13V ref
RDIV_1	10k/90k divider on Ohms Cal assembly
ZERO_TEMP	Recorded temperature for zero calibration
ALL_TEMP	Recorded temperature main output calibration
G5205D	5205A gain, dc
G5205A	5205A gain, ac
G5220	5220A gain
W1G	1.1 mV wideband gain
W2G	3.3 mV wideband gain
W3G	11 mV wideband gain
W4G	33 mV wideband gain
W5G	110 mV wideband gain
W6G	330 mV wideband gain
W7G	1.1V wideband gain
W8G	3.5V wideband gain
WL1	Wideband thermal sensor correction constant #1
WL2	Wideband thermal sensor correction constant #2
WL3	Wideband thermal sensor buffer offset
WBAND_TEMP	Recorded temperature for wideband gains calibration
WF1	No attenuators wideband flatness correction, 1 kHz
WF2	Same, 12 kHz
WF3	Same, 100 kHz
WF4	Same, 500 kHz
WF5	Same, 1.1999 MHz
WF6	Same, 1.2 MHz
WF7	Same, 2 MHz
WF8	Same, 10 MHz
WF9	Same, 20 MHz
WFA	Same, 30 MHz
WFB	(Spare)
WFC	(Spare)
W1F1	10 dB attenuator wideband flatness correction, 1 kHz
W1F2	Same, 12 kHz
W1F3	Same, 100 kHz
W1F4	Same, 500 kHz
W1F5	Same, 1.1999 MHz

NAME	DESCRIPTION
W1F6	Same, 1.2 MHz
W1F7	Same, 2 MHz
W1F8	Same, 10 MHz
W1F9	Same, 20 MHz
W1FA	Same, 30 MHz
W1FB	(Spare)
W1FC	(Spare)
W2F1	20 dB attenuator wideband flatness correction, 1 kHz
W2F2	Same, 12 kHz
W2F3	Same, 100 kHz
W2F4	Same, 500 kHz
W2F5	Same, 1.1999 MHz
W2F6	Same, 1.2 MHz
W2F7	Same, 2 MHz
W2F8	Same, 10 MHz
W2F9	Same, 20 MHz
W2FA	Same, 30 MHz
W2FB	(Spare)
W2FC	(Spare)
W3F1	10 dB and 20 dB together wideband rf correction, 1 kHz
W3F2	Same, 10 MHz
W3F3	Same, 20 MHz
W3F4	Same, 30 MHz
W3F5	(Spare)
W3F6	(Spare)
W4F1	40 dB attenuator wideband flatness correction, 1 kHz
W4F2	Same, 12 kHz
W4F3	Same, 100 kHz
W4F4	Same, 500 kHz
W4F5	Same, 1.1999 MHz
W4F6	Same, 1.2 MHz
W4F7	Same, 2 MHz
W4F8	Same, 10 MHz
W4F9	Same, 20 MHz
W4FA	Same, 30 MHz
W4FB	(Spare)
W4FC	(Spare)
W5F1	10 dB and 40 dB together wideband rf correction, 1 kHz
W5F2	Same, 10 MHz
W5F3	Same, 20 MHz
W5F4	Same, 30 MHz
W5F5	(Spare)
W5F6	(Spare)
WB__FLAT__TEMP	Recorded temperature for wideband flatness calibration
TW1	Manual range adjust, 220 mV dc

NAME	DESCRIPTION
A6F5	Same, 100 kHz
A6F6	Same, 119.99 kHz
A6F7	Same, 120 kHz
A6F8	Same, 200 kHz
A6F9	Same, 300 kHz
A6FA	Same, 400 kHz
A6FB	Same, 500 kHz
A6FC	Same, 600 kHz
A6FD	Same, 700 kHz
A6FE	Same, 800 kHz
A6FF	Same, 900 kHz
A6FG	Same, 1 MHz
A6FH	(Spare)
A6FI	(Spare)
A6FJ	(Spare)
A6FK	(Spare)
A6FL	(Spare)
A7G	1100V range gain
A7F1	1100V range, first flatness correction, 300 Hz
A7F2	Same, 500 Hz
A7F3	Same, 700 Hz
A7F4	Same, 1 kHz
A7F5	(Spare)
A7F6	(Spare)
I1Z	220 μA range zero
I1G	220 μA range gain
I2Z	2.2 mA range zero
I2G	2.2 mA range gain
I3Z	22 mA range zero
I3G	22 mA range gain
I4Z	220 mA range zero
I4G	220 mA range gain
I5Z	2.2A range zero
I5G	2.2A range gain
IGME	Measurement at bottom of resistor during gain cal
I1F1	220 μA ac, 500 Hz
I1F2	Same, 1 kHz
I1F3	Same, 2 kHz
I1F4	Same, 5 kHz
I1F5	Same, 7 kHz
I1F6	Same, 10 kHz
I1F7	(Spare)
I1F8	(Spare)
I2F1	2.2 mA ac, 500 Hz
I2F2	Same, 1 kHz

NAME	DESCRIPTION
I2F3	Same, 2 kHz
I2F4	Same, 5 kHz
I2F5	Same, 7 kHz
I2F6	Same, 10 kHz
I2F7	(Spare)
I2F8	(Spare)
I3F1	22 mA ac, 500 Hz
I3F2	Same, 1 kHz
I3F3	Same, 2 kHz
I3F4	Same, 5 kHz
I3F5	Same, 7 kHz
I3F6	Same, 10 kHz
I3F7	(Spare)
I3F8	(Spare)
I4F1	220 mA ac, 500 Hz
I4F2	Same, 1 kHz
I4F3	Same, 2 kHz
I4F4	Same, 5 kHz
I4F5	Same, 7 kHz
I4F6	Same, 10 kHz
I4F7	(Spare)
I4F8	(Spare)
I5F1	2.2A ac, 500 Hz
I5F2	Same, 1 kHz
I5F3	Same, 2 kHz
I5F4	Same, 5 kHz
I5F5	Same, 7 kHz
I5F6	Same, 10 kHz
I5F7	(Spare)
I5F8	(Spare)
IMZ	Current monitor circuit zero
IMAG	Current monitor circuit ac gain
IMDG	Current monitor circuit dc gain
RS10	10 kΩ standard true value (on Ohms Cal assembly)
R0	0Ω true value
R1	1Ω true value
R1_9	1.9Ω true value
R10	10Ω true value
R19	19Ω true value
R100	100Ω true value
R190	190Ω true value
R1K	1 kΩ true value
R1_9K	1.9 kΩ true value
R10K	10 kΩ true value
R19K	19 kΩ true value

NAME	DESCRIPTION
A4V5	Same, 50 kHz
A4V6	Same, 70 kHz
A4V7	Same, 100 kHz
A4V8	Same, 119.99 kHz
A4V9	Same, 200 kHz
A4VA	Same, 300 kHz
A4VB	Same, 400 kHz
A4VC	Same, 500 kHz
A4VD	Same, 600 kHz
A4VE	Same, 700 kHz
A4VF	Same, 800 kHz
A4VG	Same, 900 kHz
A4VH	Same, 1 MHz
A4VI	Same, 1.1 MHz
A4VJ	Same, 1.1999 MHz
A5G	22V range gain
A5S	22V range standing wave ratio correction
A5D	22V range 8-bit dac constant
A5F1	2.2V range, first flatness correction, 20 kHz
A5F2	Same, 50 kHz
A5F3	Same, 100 kHz
A5F4	Same, 119.99 kHz
A5F5	Same, 120 kHz
A5F6	Same, 200 kHz
A5F7	Same, 300 kHz
A5F8	Same, 400 kHz
A5F9	Same, 500 kHz
A5FA	Same, 600 kHz
A5FB	Same, 700 kHz
A5FC	Same, 800 kHz
A5FD	Same, 900 kHz
A5FE	Same, 1 MHz
A5FF	Same, 1.1 MHz
A5FG	Same, 1.1999 MHz
A5FH	(Spare)
A5FI	(Spare)
A5C1	22V range, first convergence correction
A5C2	Same, 200 Hz
A5C3	Same, 5 kHz
A5C4	Same, 20 kHz
A5C5	Same, 50 kHz
A5C6	Same, 70 kHz
A5C7	Same, 100 kHz
A5C8	Same, 119.99 kHz
A5C9	Same, 200 kHz

NAME	DESCRIPTION
A5CA	Same, 300 kHz
A5CB	Same, 400 kHz
A5CC	Same, 500 kHz
A5CD	Same, 600 kHz
A5CE	Same, 700 kHz
A5CF	Same, 800 kHz
A5CG	Same, 900 kHz
A5CH	Same, 1 MHz
A5CI	Same, 1.1 MHz
A5CJ	Same, 1.1999 MHz
A5V1	22V range, first 1/V convergence correction
A5V2	Same, 200 Hz
A5V3	Same, 5 kHz
A5V4	Same, 20 kHz
A5V5	Same, 50 kHz
A5V6	Same, 70 kHz
A5V7	Same, 100 kHz
A5V8	Same, 119.99 kHz
A5V9	Same, 200 kHz
A5VA	Same, 300 kHz
A5VB	Same, 400 kHz
A5VC	Same, 500 kHz
A5VD	Same, 600 kHz
A5VE	Same, 700 kHz
A5VF	Same, 800 kHz
A5VG	Same, 900 kHz
A5VH	Same, 1 MHz
A5VI	Same, 1.1 MHz
A5VJ	Same, 1.1999 MHz
A6G	220V range basic gain
A6S	220V range standing wave ratio correction
A6D1	220V range, first freq. dependent 8-bit dac constant, 10 kHz
A6D2	Same, 50 kHz
A6D3	Same, 120 kHz
A6D4	Same, 300 kHz
A6D5	Same, 500 kHz
A6D6	Same, 600 kHz
A6D7	Same, 700 kHz
A6D8	Same, 800 kHz
A6D9	Same, 900 kHz
A6DA	Same, 1 MHz
A6F1	220V range, first flatness correction, 5 kHz
A6F2	Same, 10 kHz
A6F3	Same, 20 kHz
A6F4	Same, 50 kHz

Appendix E
Sales and Service Centers

U.S. SALES AREAS for all Fluke products

Alabama

Huntsville
4920 Corporate Drive
Suite J
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